RIDDLE OF THE SPIRIT

Promoting sustainability
through play design in Finnish education

Chin Chin Wong

Master's Thesis 2018, Creative Sustainability

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**“All things,
both animate and inanimate,
had their own spirit…”**

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Abstract

Children are learning every moment; every childhood experience could influence their life-long values, behavioural development towards a sustainable way of living. To understand the new complex phenomena and make changes, children need relatively different competences, such as eco-literacy, empathy and systems thinking. Play, as a key way to explore the world, is seen as a significant element for promoting education for sustainability in childhood. Therefore, this thesis presents a new playset design as an alternative learning experience for children to study the abstract concept of sustainability.

Setting Finland as the research context, this research examines how play design might promote climate education with diverse playthings and activities in Finnish early childhood and primary schools. The aim is to enhance children's environmental knowledge, awareness and sense of responsibility, thus supporting teachers promoting relevant topics as ready-made learning materials. The set consists of one riddle as the storyline, seven playful activities with paper-based toys and templates. During the play, students acquire knowledge progressively and build the connection between themselves and climate issues through the story of an unwell "thunderstorms spirit", inspired by Finnish myths, as core discussion. On the whole, the pedagogical framework combines elements of purposefully framed play, multi-literacy, phenomenon-based learning and imaginative education to deliver the learning goals of education for sustainability.

The weight of this study lies on the practical design process of the playset. It involves methodology of transdisciplinary design research, double-diamond model, design thinking and user involvements. Contextual research includes interviews with educators and teachers, observation in a kindergarten, workshops, an analysis of the Finnish curriculum with a selected education model EarthCore by Worldwatch Institute. Further research will be collecting feedback from users to understand the exact application and produce more playful learning materials with other sustainability topics.

Key words: Play design, education for sustainability, Finnish early childhood and primary education, playful learning.

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Introduction

Children, as the next generation, are important stakeholders in building a sustainable future. In this era, they are born into the world with multiple global issues, such as climate change, loss of biodiversity and poverty. Understanding such complex phenomena and identifying connections between the issues are increasingly seen as essential skills for this generation to tackle challenges. Besides, childhood play and nature experience seem to be recognized as important elements in cultivating one's life-long values and adult environmental behaviours. However, due to urbanization, digitization and commercialization, childhood playtime nowadays has reduced significantly.

As a designer, I have been studying the connection between play design and education for sustainability for at least seven years. I worked as a toy designer in Hong Kong and a start-up entrepreneur to promote playful learning in local schools. As a Creative Sustainability student with this background, my main interest is to further explore the design possibility to advocate behavioural change of young children towards sustainable living through play. Therefore, this thesis presents a new playset design (*Image 1*) as an alternative learning experience for children to study the abstract concept of sustainability. The aim is to nurture children's environmental awareness and sense of responsibility, as well as relevant skills and knowledge to understand complex sustainable issues. Through solving the riddle of the unwell "thunderstorms spirit", children explore the connection between themselves and climate issues through the story and play. These playful learning tools combine diverse play types with the structure of teachers' facilitation, children's self-exploration and story-led discussion. This creative outcome was tested with two classes of students (seven to nine years old) and teachers in a primary school. The result was positive and successful. Students learned and discussed climate-issue-relevant concepts such as "carbon footprint", "greenhouse gases" and "global

Image 1. The entire set of playset design Riddle of the Spirit

warming" during activities. And they understood changing their own daily practices, such as recycling, consumption and minimizing pollution, could help the thunderstorms spirit, as well as the climate issues. Student's active engagement and feedback validated the values of this study.

Besides the playset, other important outcomes of this study are its pedagogical framework, design process and an analysis of Finnish education. To enrich educational values of the design, I look into different education models for sustainability and select *EarthCore framework* from *Worldwatch* Institute (Assadourian & Mastny, 2017) as a core reference. A set of relevant competences, such as eco-literacy, empathy, system thinking and collaboration, is identified and embedded into the design as part of the learning values. More, Finnish education, as the research context, has been highly valued by various media. For this reason, I attempt to adapt its values, such as child-centric play and phenomenon-based learning, into the design by analysing its curriculum and working with multiple local educators. Through collaborating with the research lab Playful Learning Centre in University of Helsinki (www.plchelsinki.fi), I have the opportunity to connect with the

local stakeholders and look at this topic from both design and education perspectives. Another aim of the playset is to support teachers implementing the new curriculum multi-disciplinary modules as ready-made learning materials.

In this report, I will start with a general review of recent studies about the importance of children's play and education for sustainability as background. The analysis of Finnish education in Chapter 2 attempts to identify relevant key values, strengths and opportunities of this system in promoting sustainability education through play. In Chapter 3, I will explain the research-through-design process and methodologies applied, including the structure, user involvement methods and the nature of trans-disciplinary design research. Chapter 4 *Play & Design* will explore the nature of playful learning design in this thesis with an overview of existing play theories. After that, the playset, its framework and the trial session with children will be narrated in Chapter 5. The last chapter will discuss the key findings, as well as reflect on the validity, limitation and implications for further research.

All photos in this report are taken by the author with the documentation premission of participants, details in sub-chapter 3.3.

1 Background

1
Background

1.1 Decline of play in twenty-first-century childhood

The starting point of my thesis is to address the widely reported decline of play opportunities in the contemporary urbanized childhood. In the twenty-first century, children grow up in a rapidly urbanizing and changing world. Nowadays, over 55% of the world population lives in cities and the figure is estimated as 66% by 2050 (Unicef, 2017). In this global phenomenon, children grow up in an environment with significant population density and a relatively different built-environment setting comparing to a few decades ago. To understand the impacts of urbanization on child development, quantitative studies have been taken to identify key issues. Key issues found include digitalized and commercialized childhood, crime and safety, parental anxieties, so-called "academification" and "indoorification" of young children's lives (Jensen et al., 2012; Sobel, 2017; Golin & Campbell, 2017; Linn, 2010). This literature points to a significant decline of children's play opportunities and its negative impacts.

Children today will inevitably be immersed in capitalism and consumer culture. Exposing to commercialized brands and products, children and adults are repeatedly taught consumption as a measure of success and a path to happiness. An educator Erik Assadourian pointed out the impacts of marketing approaches targeting on children from babyhood onwards to childhood and adulthood, thus leading to a consumption-oriented unsustainable lifestyle (Jensen et al., 2012). Studies also suggested the increased use of digital media was one reason for children staying indoors instead of outdoor nature, hence leading to the decline of free play time and increased exposure to commercial marketing (Sobel, 2017; Golin & Campbell, 2017). Besides, commercials strongly affected children's values and perceptions of material consumption, beauty and perfection, their physical and mental health (such as obesity, depression and low self-esteem) (Linn, 2010; Jensen, 2012). These issues caused by the commercialization and digitalization also lead to a certain level of parental anxiety. In the introductory workshop of this study, a group of parents expressed their concerns about commercials to their children's value development and parent-child relationships. They described the increase in social media usage strongly affected their children's perceptions, behaviours and consumption patterns; at the same time, there was a decline in family communication and interaction opportunities.

So-called "indoorification" and "academification" of childhood have also been identified as main causes leading to the decline of play (Sobel, 2017). A child-friendly urban environment is vital for child health, well-being and development; it provides opportunities for outdoor play, social interaction and exploration of environmental knowledge (Kyttä et al., 2018). However, it is challenging to provide children a relevant level of independent mobility within a high-dense context, due to conditions such as crime and safety, germs and disease, and traffic in the neighbourhood. These conditions can result in an increased time for children to stay indoors. In addition, one significant example of "academification" of childhood would be the idea "earlier is better" from United Kingdom supporting an earlier introduction of formal schooling to young children. This has influenced numerous countries to lower the age requirement for children to start schools (Whitebread & Bingham, 2012). However, this idea has been recognized

as a destructive belief in children's well-being, resulting in decrease of play and outdoor time. In contrast, persuasive evidence has proved a longer period of informal playful learning and later start of formal education were advantageous for developing an individual's intellectual and learning abilities (Whitebread, 2017).

Entering the twenty-first century, a sudden increase in children's mental health problems is found by researches. Referring to the study conducted by U.K. National Health Service (Campbell & Marsh, 2016), data-revealed problems include increases in clinical-level anxiety, depression and self-harming of children, below the age of ten. A great number of studies by anthropologists and developmental psychologists have validated the decline of play as one cause of the increase of children's mental health problems and their difficulties during schooling (Whitebread, 2017). The value of play has been strongly supported in promoting the mental health of young people.

The above-mentioned global phenomena and issues are closely interconnected. The rapid increase of children's mental health problems, which is believed to be connected to the decline of play time, highlights the emergency to advocate changes for an alternative living in the urbanized childhood. Although children's play has often been seen as serving no purpose and which children would eventually grow out of; however, it is persuasively proved to be beneficial and critical to children's learning and development. As supported by the research evidence, there is an impression of a need for an alternative social perspective of children's play. Therefore, the starting point of my study is to rethink the normative values of children's play and well-being in the twenty-first century.

1.2 Education for Sustainability

In our daily life, our social practices are structured by surrounding materials, such as objects and infrastructures. For example, a waste sorting system shapes the way households recycle and a toy directs a child how to play with it. A scholarly usability engineer Donald Norman (1988) describes the significance of design as "affordances" and constrains the way a user uses an object. In other

words, design influences human behaviour, decisions and emotion. To promote sustainability, design is seen as a potential practice to enable social changes towards sustainable ways of living by interventions (Niedderer et al., 2016), such as social innovations, collaborative design for policy making, product and service system design.

Given the trends that have been identified, is there a way to promote alternatives for a sustainable way of living to the new generation? Although sustainability is a relatively complex concept, a significant number of initiatives worldwide have been prompted to address the issues of childhood mentioned above. Initiatives include educational, social, political and infrastructural. For instance, policies, such as regulating children-targeted marketing and promoting a commercial-free environment in schools, have successfully demonstrated methods to limit children's exposure to commercials and biased materialistic values in different countries (Golin & Campbell, 2017). Another example would be the campaign "Play Streets" in the United Kingdom and the United States, which aimed to increase children's independent mobility by expanding outdoor neighbourhood play area (Whitebread, 2017). In terms of educational context, a review article (Hedefalk, Almqvist & Östman, 2015) showed that education for sustainability development (ESD) was a growing topic in the field of early childhood education (ECE) as more than double amounts of relevant articles have been published comparing to two decades ago. Numerous overlapping movements have recognized education for sustainability as the goal for a liveable future. Movements include "green schools", outdoor schools, forest kindergartens, nature-based education and the farm-to-school movement (Sobel, 2017). Among these movements, this thesis would like to highlight an educational framework, *Earth Education Core Principles* (EarthCore) (Assadourian, 2017), which will be used as core reference throughout the study. This framework is seen appropriate as it summarizes six tenets (which have been discussed in some other forms) and prioritizes the essential elements into an integrated model.

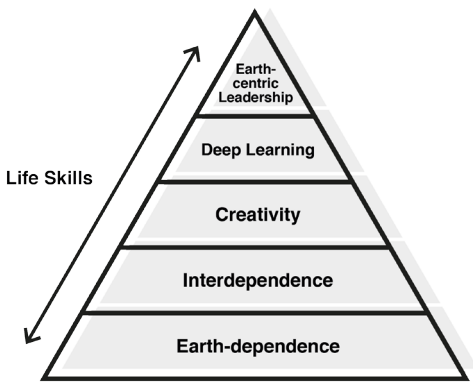


Figure 1. Earth Education Core Principles (EarthCore) (Assadourian, 2017)

Growing up in a rapidly changing context

with complex issues such as climate change, what skills and knowledge do the new generations need to adapt better in future? In 2017, Worldwatch Institute has published its thirty-fourth *State of the World* Report *EarthEd: Rethinking Education on a Changing Planet* (Assadourian & Mastny, 2017). This report collects a series of articles written by multiple professionals worldwide to discourse on the topic of education for sustainability. In the introduction chapter, Assadourian (2017) presents a theoretical framework, *Earth Education Core Principles* (EarthCore), *Figure 1*, as the key model throughout the report. This model illustrates an educational prioritization reform, which identifies the knowledge and skills that would be useful for the new generation to survive and adapt to the ecological shifts ahead. The model stresses to emerge educational priorities including eco-literacy, moral education, systems thinking and critical thinking, thus nurturing student's resilience and adaptability to the future transitions. This framework will be further discussed in Chapter 2.

In the article *Prioritizing Play* of the report, David Whitebread (2017) specifically discussed the value of play in supporting children's value development towards sustainability. *Free play*, in other words, *unguided play* or *self-directed play*, has also been referred to validate its significance in children's learning and development, such as emotional and physical health, creativity, problem-solving skills and critical thinking (Golin & Campbell, 2017; Sobel, 2017; Whitebread, 2017). Moreover, Marilyn Mehlmann and her team (2017) demonstrated using comics to leverage play in the form of the arts as an educational medium to actively engage students, develop awareness and empathy towards sustainability. Other play types were also discussed throughout the report to support the argument, including *creative play, story-telling, object play, pretend play* and *symbolic play* (Mehlmann, et al., 2017; Whitebread, 2017).

Promoting sustainability through education is certainly important; however, it is difficult to assess its actual influence on children's behavioural development towards a sustainable way of living. One challenge is the value-action gap between individuals' environmental knowledge, environmental awareness and pro-environmental behaviours; for instance, an individual understanding the importance of recycling (environmental knowledge and awareness)

but not necessarily practicing waste sorting (pro-environmental behaviour). In this context, 'pro-environmental behaviour' refers to behaviour that "consciously seeks to minimize the negative impact of one's actions on the natural and built world" (Kollmuss & Agyeman, 2002, p. 240).

Pro-environmental behaviour is difficult to assess or measure, as it is shaped by multiple factors. *Figure 2* below, developed by researchers Anja Kollmuss & Julian Agyeman (2002), is a model illustrates the interconnected influences for developing one's pro-environmental behaviour. In short, situational factors, such as the built environment and social norms, affect the development of environmental consciousness and actions. The other way around, one's actions influence the formation of social norms and structure, such as political actions. In the other words, promoting sustainable ways of living requires constantly changing the situational factors, for instance, infrastructure and policies. At the same time, it also demands individual's knowledge and ability to critically evaluate global issues and normative values against the environmental impacts from multiple perspectives.

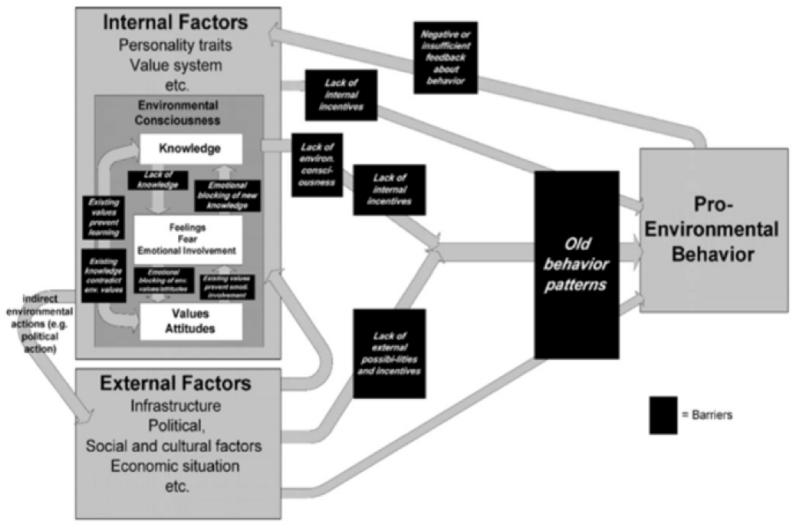


Figure 2. The model of pro-environmental behaviour (Kollmuss & Agyeman, 2002)

In Finland, the idea of developing a "sustainable way of living" is believed as a necessary educational ambition (FNBE, 2017). The new Finnish national core curriculum embeds the values of sustainability in diverse dimensions

and acts as a unified direction for the local education providers. As sustainability is a relatively abstract concept, teachers demand guidelines and materials to promote this topic. Therefore, in this thesis, I am going to explore the possibility of alternative learning materials to promote the concept of sustainability in Finnish classrooms, thus supporting teachers to adapt the new curriculum.

1.3 Playful learning in early childhood as an intervention

Children are learning every moment; every childhood experience influences their pro-environmental behaviours in adulthood. Environmental psychologists Louise Chawla and Victoria Derr (2012) have validated childhood play and learning experience in nature crucially influenced their adult environmental behaviour. Studies also suggested the earliest years of life, such as the age before eleven, is a critical period in shaping life-long values and developing behaviours towards environment (Tilbury, 1994; Liefländer et al., 2013). The age between seven to eleven is recognized as the Piaget's Concrete Operational stage (Piaget, 1951),

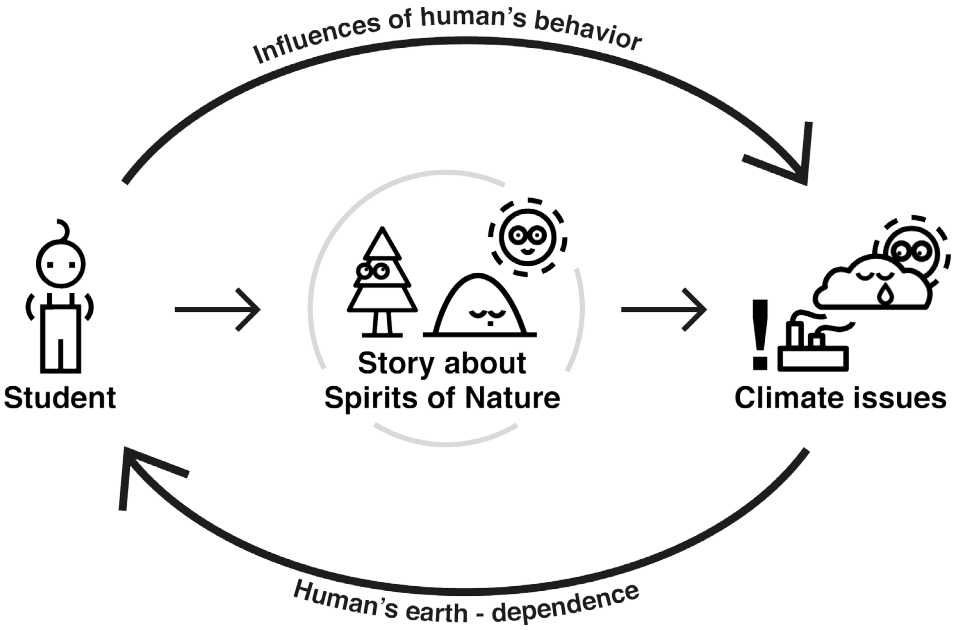


Figure 3. Students connect themselves to climate issues through the story

which children start using logical thinking and inductive reasoning to understand abstract concepts, for instance, sustainability. Therefore, this thesis focused on the age under eleven and tested the new playset design with children from seven to nine years old.

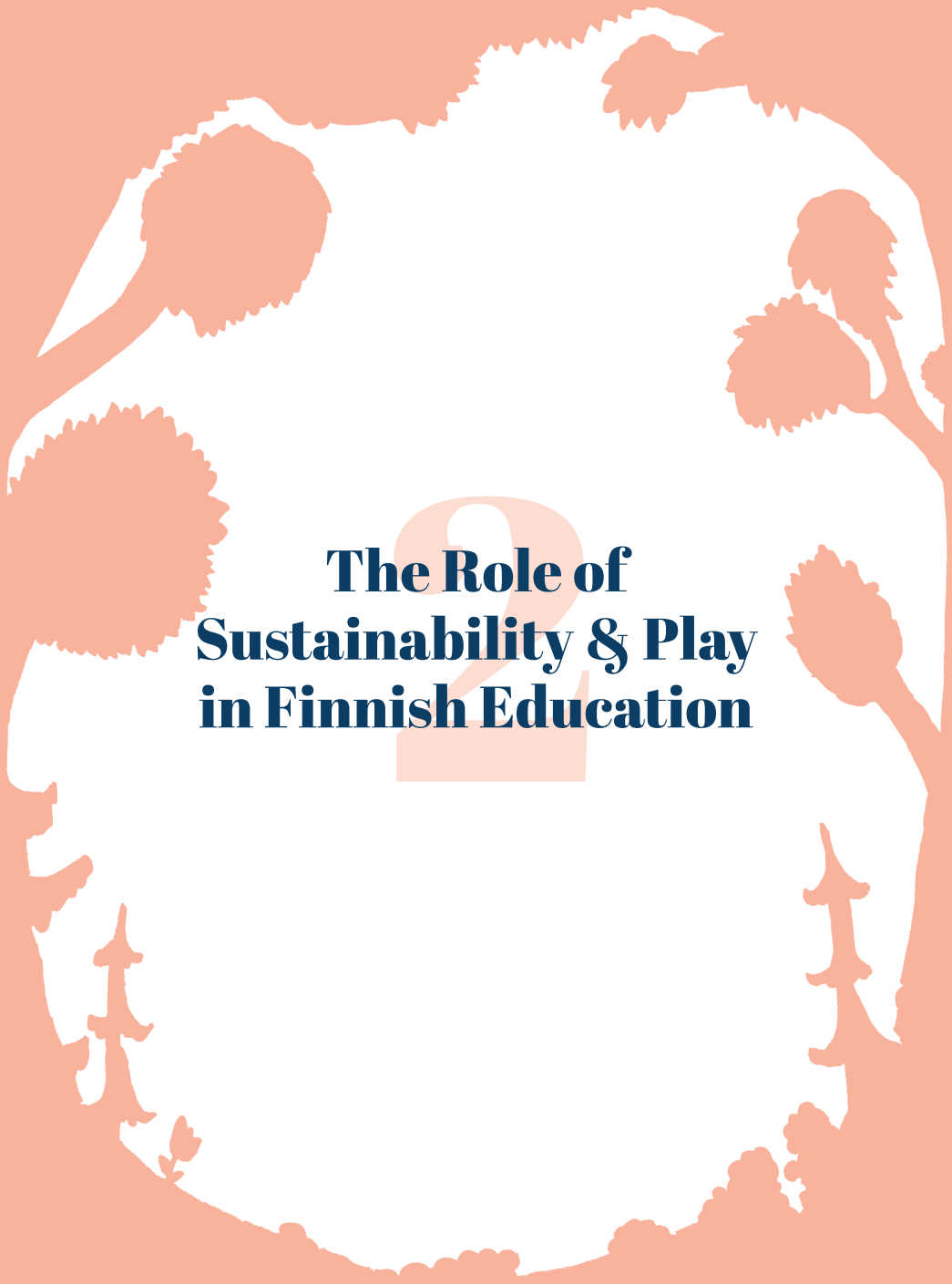
This project is developed collaboratively with Playful Learning Centre (PLC) in University of Helsinki for the context of the Finnish education system. The new design *Riddle of the Spirit* is an extension outcome of a PLC existing project *Whisper of the Spirit* (Erfving et al, 2017), which is a collection of activity cards aiming to raise children's interests in Finnish myths, nature, and multiliteracy competencies. The activities begin with the narrative of a Finnish ancient belief "*All things, both animate and inanimate, had their own spirit…*" (Erfving et al, 2017, p.4). As a play designer and researcher, I identified the opportunity to embed further learning goals of education for sustainability with the spirit characters and story background established. Therefore, I proposed a new playset *Riddle of the Spirit* as playful learning tools for children to explore the relationship between human behaviour, the climate issues and the "spirits", *Figure 3*. The intention is to promote this complex topic of sustainability with elements children familiar with, such as play, story and characters, thus enhancing their sense of responsibility to the environment by emotional involvement with the "spirits" characters. Taking climate change as the content, in a total of seven activities provide diverse playful ways to explore this phenomenon, for example, finding out relevant keywords by decoding the "spirit language" and role-playing the "spirit" characters to increase the sense of empathy.

In a general level, the pedagogical framework of this playset combines the elements of multiliteracy, phenomenon-based learning and imaginative approaches (Egan, 2005) to deliver the learning goals of climate education and EarthCore Principles (Assadourian, 2017) through purposefully framed play (Cutter-Mackenzie and Edwards, 2013). This game is designed to be distributed to kindergarten and elementary schools in Finland as creative commons for non-commercial purposes, thus supporting the idea of commercial-free learning environments for children.

My main research question is: *in a Finnish primary school context, how might the design of a playful learning playset promote education for sustainability?* More, my study explores the following three sub-questions:

- **Design criteria** - What educators' expectations and learning goals should the playset design include to promote education for sustainability?
- **Play design** – How is the playful learning experience created so as to achieve the design criteria?
- **Values and impacts** - How might the design intervention enhance education for sustainability in Finnish education?

This is a transdisciplinary design project; the topic is studied across three different disciplines: design, education and sustainability. The weight of this study lies on the practical design process of the playset. It involves methodologies of the double-diamond model (Design Council, 2017), design thinking, ideation to prototyping and user involvements, such as interviews and workshops. Various stakeholders, such as educators, teachers and designers, are engaged in different stages to achieve the feasible outcome for the Finnish classrooms. To understand the education system, I analyse the values of play and sustainability in the new Finnish core curriculum through referencing the EarthCore Principles (Assadourian, 2017), which will be further discussed in the next chapter.



2 The Role of Sustainability & Play in Finnish Education

2

The Role of Sustainability & Play in Finnish Education

Finland is believed to have its advantages for sustainable development. A Finnish government's analysis study suggested that Finland had a relatively high potential for achieving the UN sustainable development goals for 2030. The favourable conditions included relatively evenly distributed wealth, the high-quality education, high stability and functioning of society and comparatively low corruption (Lyytimäki & Lähteenoja, 2016). Under these privileges, Finland is a relatively productive context to explore the topic of education for sustainability. This thesis focuses on the context of Finnish early childhood and primary education. I will outline and analyse the values of sustainability and play in the Finnish national core curriculum through the lens of EarthCore principles (Assadourian, 2017) and my empirical studies. This chapter provides a general understanding of the Finnish school context, thus identifying design criteria as a guideline for developing the play design intervention. The empirical studies mainly refer to the six interviews, two workshops, one kindergarten observation and one prototype testing session, which were conducted in Helsinki and Espoo.

2.1 The new Finnish national core curriculum

Finland has been constantly recognized by media as one of the world leaders in education systems. In general, recognized system features includes the emphasis of play in early childhood, late start of formal education (at the age of seven), long recess for elementary students, minimized standardized testing, highly educated teachers and flexible local implementation of the national core curriculum (Bulter, 2016; Taylor, 2012; Hart, 2017; McGowan, 2018). One of the successful elements was that it achieved the smallest difference between the weakest and strongest students in the world (Alexander, H. & Orange, R., 2013; Taylor, 2012). In fact, the transformation of the Finnish education system has begun more than 40 years ago as one key drive of the country's economic recovery plan (OECD, 2010). In 2014, Finnish National Board of Education (FNBE) published the new national core curriculum and it has been implemented locally in grade one to six from August 2016.

This curriculum has an important role in the system as it steers the arrangement of education for all children in Finland. It is created through a collaborative planning process, which more than 300 citizens and professionals were engaged in working together with FNBE. It acts as a collective shared vision and local educational institutions must develop their local curriculum based on it (FNBE, 2016a). Therefore, I will focus on analysing the documents of the new national core curriculum provided by FNBE. This analysis will cover *early childhood education and care* (0-5 years old), *pre-primary education* (6 years old) and *early primary education* (7 to 9 year olds)) of the so-called *basic education*. The following *Table 1* summarizes the main underlying values, the concept of learning and transversal competences of the three systems (FNBE, 2016a; FNBE, 2016b; FNBE, 2017).

The three systems have unified underlying values as the foundation of curriculum. In *Table 1*, I summarized and quoted four main values: the intrinsic of childhood; the rights of the child; equity, equality and diversity; and necessity of a sustainable way of living.

Table 1. A summary of the main underlying values, the concept of learning and transversal competences of the Finnish national core curriculum

Curriculum	Early childhood education and care	Pre-primary education	Basic education
Age grade	0-5	6	7-16
Underlying values	**The intrinsic values of childhood** *Uniqueness and values of each child*		
	The rights of the child *Right to good instruction, caring, expressing opinions and thoughts*		
	Growth as a human being, equity, equality and diversity *Including diversity of families, democratic values, gender equality, cultural diversity*		
	Necessity of a sustainable way of living *Taking its social, cultural, economic and ecological dimensions*		
The concept of learning	**Student as the active learner**		
	Connecting new knowledge and skills to everyday life *previous experiences of children, their interests, and their competences as the starting point for learning*		
	Emphasis of play *Play as source of development, learning and well-being*		
	Holistic learning *Combining knowledge, skills, actions, emotions, sensory perceptions, bodily experiences and thinking*		
	Participation in planning activities *Learning to work in cooperation with others and set goals for activities*		
	Developing learning-to-learn skills *Becoming aware of their personal ways of learning*		
Transversal competences	**Five transversal competences:** • Thinking and learning • Cultural competence, interaction and self-expression • Taking care of oneself and managing daily life • Multiliteracy and competence in information and communication technology • Participation and involvement		**Seven transversal competences:** • Thinking and learning to learn • Cultural competence, interaction and self-expression • Taking care of oneself and managing daily life • Multiliteracy • ICT Competence • Working life competence and entrepreneurship • Participation, involvement and building a sustainable future

The concept of learning for early childhood education and care and pre-primary education create a continuum and are nearly the same. These two systems emphasize children's interests and experiences as starting points for learning, as well as the intrinsic and pedagogical values of play. Correspondingly, during interviews, local educators and a kindergarten teacher also remarked children's interest as main consideration for learning activities. In general, interviewees agreed play was seen as the main pedagogical approach for children under seven years old. Apart from this, the three systems also highlight the values of participation and social interaction, as well as learning-to-learn skills.

Transversal competence is defined as "*an entity consisting of knowledge, skills, values, attitudes and will*" (FNBE, 2016a, p. 21). The documents also pointed out how these transversal competences would assist students to connect knowledge and skills from different fields to understand complex and new phenomena. In detail, the two systems early childhood education and care and pre-primary education narrate five transversal competences: "thinking and learning"; "cultural competence, interaction and self-expression"; "taking care of oneself and managing daily life"; "multiliteracy and competence in information and communication technology"; and "participation and involvement". Building on top of these, basic education additionally includes the competences of "working life competence and entrepreneurship" and "building a sustainable future". These transversal competences highlighted the values of sustainability as the shared vision.

Moreover, the new national core curriculum emphasizes the integrative instruction and multidisciplinary learning modules (MLs) as the main teaching methods to cultivate students' transversal competences. MLs are the study periods with integrative instruction, which refers to the pedagogical approach where real-world phenomena are examined as wholes in each subject. This approach sees students as active "knowledge builders" and the purpose is to enable them to link knowledge from various fields and understand relationships between phenomena. The basic education curriculum (FNBE, 2016a) states educator providers must implement at least one MLs per school year through cooperation between subjects. For example, in my empirical study, primary-school teachers described students (first and second grade) completed five to six MLs per year, which referred to 50 -70% time in theme-based activities across disciplines. During my visit, students were in a project "bug life", which they studied insects from different perspectives, such as biology, poetry, art and craft.

In short, the main features of the Finnish new core curriculum include the emphasis of multidisciplinary learning modules (MLs) as pedagogical approaches to nurture students' transversal competences as objectives. This context study is important to the new playset design since it outlines the general ways of working, underlying values of the Finnish education system. This information is a reference

to ensure the feasibility of design outcome.

2.2 Value analysis against EarthCore

Here, I analyse the role of sustainability in the Finnish national core curriculum through referencing the six-principle framework of EarthCore (Assadourian, 2017) mentioned earlier in Chapter 1. I will also summarize the strengths and opportunities of the Finnish education in terms of education for sustainability. The aim of this analysis is to understand the core values of Finnish education and embed to the playset design to ensure its context relevance, thus identifying opportunities for intervention.

The Earth Education Core Principles (EarthCore) (Assadourian, 2017), *Figure 1* (shown earlier), developed by the Worldwatch Institute, portrays an educational prioritization aiming to nurture the new generation with relevant knowledge and skills to survive in the future ecological collapse and sustainability transitions. This model consists of six principles, each building on the former and interconnected in a certain degree. These six aspects have been discussed in some other forms and EarthCore attempts to connect the principles as an integrated framework. This model is used as a key reference in this thesis since it advocates to embed these principles into students' learning experience to promote education for sustainability. It acts

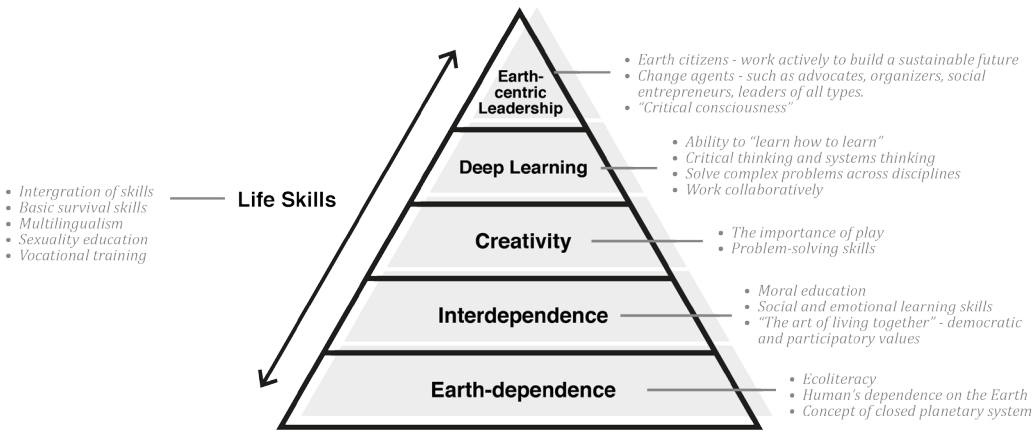


Figure 1. Earth Education Core Principles (EarthCore) (Assadourian, 2017)

as an indicator to guide the playset development which is discussed further in Chapter 5.

In the national core curriculum reform, the key principles are stated as inclusive education, multifaceted and deep learning, enhancement of transversal and subject competences, and promoting sustainable ways of living (Halinen, Harmainen & Mattila, 2015). The concept of "sustainability" and "sustainable way of living" have been repeatedly stated in the official curriculum documents and appear to be two of the core values. Referring the *Table 1*, one underlying value is the "necessity of a sustainable way of living", which is selected and quoted from the basic education curriculum:

> *"Humans are part of nature and completely dependent on the vitality of ecosystems. Understanding this plays a key role in growth as a human being. Basic education acknowledges the necessity of sustainability development and ecosocial knowledge and ability, follows their principles and guides the pupils in adopting a sustainable way of living….Ecosocial knowledge and ability means that the pupils understand the seriousness of climate change, in particular, and strive for sustainability." (FNBE, 2016a, p.16)*

In this description, I would like to highlight the idea of human dependence on the Earth and the idea of "ecosocial knowledge and ability". The curriculum tends to believe that understanding the human dependence on nature is important for children's growth, which aligns with the EarthCore principle 1 explained below. The curriculum also interprets the terms "ecosocial knowledge and ability" with the example of understanding the seriousness of climate change, which recognizes the urgency of addressing global issues. In the following, I will first describe briefly the elements of each EarthCore principle, then the correspondingly values from the Finnish curriculum aligning with the principles.

Principle 1: Earth-Dependence

As the foundation of the theory pyramid, earth-dependence refers to the deep understanding of the complete dependence of humanity on the Earth. This principle emphasizes eco-literacy (ecological literacy) as a key piece

of the puzzle; which refers to "*the ability to understand the basic principles of ecology – the process by which the Earth's ecosystems sustain the web of life- and to live accordingly*" (Stone, 2017, p. 36). This foundation also suggests nature-based and place-based learning as efficient ways to deliver this learning goal.

The Finnish curriculum also emphasized the values of earth-dependence of humans and "ecosocial knowledge". The documents also require environmental studies which are similar to the concept of eco-literacy. It emphasizes children's outdoor experience as one learning approach. For example, during interviews, educators pointed out the curriculum required teachers and children spending a certain amount of time outdoors to explore the natural environment. And a kindergarten teacher reflected that children spent at least one hour outdoor almost every day.

Principle 2: Interdependence

Another important piece of puzzles to learn the concept of the closed planetary system is to understand humans' interdependence between each other, irrespective of differences, for example in culture, religion, gender and ethnic background. This principle emphasizes three fundamental elements: moral education; social and emotional learning skills (such as empathy) and "the art of living together", which highlights democratic and participatory values.

The Finnish education system explicitly values "equity, equality and diversity", which includes the diversity of families, democratic values, gender equality and cultural diversity. These concepts seem to be highly emphasized throughout different age grades. At the practical level, from my observation, several school practices reflected the values of equality and diversity, such as mixed-age and mixed-level classes.

Principle 3: Creativity

This EarthCore principle refers to the creativity and problem-solving skills of ideation and solving complex problems. Play is recognized as the key practice in developing these skills. Prioritizing play time in children's learning and development is emphasized, especially due to the impression of decreased play opportunities in the urbanized children's lives, as discussed in Chapter 1.

Referring to the core values of Finnish curriculum summarized in *Table 1*, play is highlighted as one key concept of learning, particularly before the age of seven. In Finland, the child-centric play is identified as the main method for children to learn and explore particularly before the age of seven. In interviews, educators and teachers underlined the harness of children's interest and the nature of play as the main pedagogical approaches. The play practice in a Finnish classroom context will be further discussed in the sub-chapter 2.4.

Principle 4: Deep Learning

The EarthCore principle 4 focuses on cultivating deep learning skills, which refers to the ability to "learn how to learn". This ability enables students to be more flexible and adaptable to apply knowledge and skills in another realm. Deep learning highlights systems thinking as one of the foundations, which systems thinking is defined as "*understanding that the world is made up of interconnected, nested systems, many of which follow similar rules...*" (Assadourian, 2017, p.12). The report of Worldwatch Institute identified a set of "deep learning" competences, including critical thinking, collaboration, communicating complex concepts, self-directed learning, being able to apply academic knowledge and solve problems across disciplines to the real context (McGrath and Martinez, 2017).

The ideas of transversal competences and multi-disciplinary learning modules (MLs) in Finnish curriculum have many similarities with the idea of deep learning in EarthCore. Transversal competences emphasize the ability to apply knowledge and skills in certain situations and one of the seven competences is "thinking and learning to learn", which is seen as the basis for developing other competences. This competence implies students to be independent learners and learn to "*perceive the interactive relationships and interconnections between things and to understand complex issues*" (FNBE, 2016a, p.22), which is similar to the idea of systems thinking. Apart from this, MLs and phenomenon-based learning approach also share similarities with the idea of contextualizing knowledge to a real-world context in the deep learning principle.

Principle 5: Life Skills

Referring to *Figure 1*, the principle Life Skills is seen as an integrated skill along the pyramid of EarthCore. In this model, life skills include a wide variety of abilities: basic survival skills, such as cooking and gardening; language learning; comprehensive sexuality education and vocational training. It demands the application of mixed competencies, such as critical thinking, social and emotional intelligence and creativity. Life skills are believed to be essential for students to understand complex sustainability topics. For example, learning nutrition, cooking and gardening can support students to critically analyse the impacts of climate change on food sustainability.

Among the seven transversal competences in Finnish curriculum, one is "taking care of oneself and managing daily life", which basically shares the same idea of the EarthCore principle Life Skills. The curriculum recognizes the skills of managing daily life, which cover health, safety and human relationships, are essential elements of a sustainable living. Besides, the Finnish curriculum also points out the importance of understanding technology and its impacts on daily life as basic life skills, which EarthCore does not seem to mention.

Principle 6: Earth-Centric Leadership

The top of the EarthCore pyramid is Earth-centric leadership. Earth-centric leadership is recognized as the full actualization of education for sustainability. It empowers students to be Earth citizens who work actively, such as social entrepreneurs, organizers and leaders, to advocate changes and build a sustainable future.

Similarly, the document of Finnish basic education states the last transversal competence as "participation, involvement and building a sustainable future". It emphasizes guiding students to understand the significance of their choices and ways of living to their local environment, society and nature, thus building a sustainable future through behavioural changes and participation in civic society. Moreover, another relevant transversal competence is "working life competence and entrepreneurship". This competence promotes students' positive attitude and understanding of the importance of work and enterprising, as personal responsibility and contribution to society.

This competence echoes with the Earthcore principle Earth-Centric Leadership; it enhances students' ability to be active agencies to lead and advocate alternatives.

2.3 Strengths and challenges of promoting education for sustainability in Finnish education

From the analysis above, the role of sustainability appears to be important in the Finnish new national core curriculum. The Finnish curriculum seems to echo with the values of all EarthCore principles by some means. The curriculum reform, particularly the advocacy of seven transversal competences and MLs, recognizes the urge to promote students' ability to understand interconnectivity between various phenomena through subject integration. Especially, the concept of multiliteracy, which refers to the competence "*to interpret, produce and make a value judgement across a variety of different texts*" (FNBE, 2016a, p. 23). It also acknowledges students' development of critical thinking and other learning skills through diverse forms of cultural communication. Multiliteracy seems to be an important element in the holistic educational approach. Besides, comparing to EarthCore, Finnish curriculum seems to promote understanding the role of technology and socio-technical impacts as basic competences. This shows the curriculum recognizes the importance of digitalization and its impact on individuals' daily choices and the natural environment. Furthermore, the role of play practice is highly emphasized as a key pedagogical approach in children's learning, development and well-being, particularly before the age of seven.

In the new curriculum reform, FNBE outlines a vision that emphasizes leading pupils to a sustainable future. However, my study also identifies several challenges and opportunities for this education system reform in terms of practical implementation. One key feature of Finnish education is the flexibility in local pedagogical implementations. The national core curriculum is openly written and leaves space for local variations. Teachers can develop their local implementations based on this curriculum; whereas quality assurance is based on steering instead of controlling. In

this approach, the education system is basically built on trust and responsibility and local educational institutions play a critical role in execution. However, this flexibility also brings challenges to teachers and the system to assure the education outcome quality in different schools. According to Paula Karlsson's study (2017), a CS master thesis about teachers' perspectives on the new national core curriculum, the study revealed a gap between the top-down education system from FNBE and the bottom-up system of schools and their teachers on a practical level. Karlsson pointed out common goals between these two systems were missing and teacher struggled to adapt to this educational reform. The study identified three main challenges in teachers' perspective: getting phenomenon-based learning started, narrowing down and finding a suitable theme and feeling concern of heavy workload. Analogously, one of my interviewees, an environmental educator of promoting climate education in Helsinki, also reflected the fact that teachers of basic education tended to have insufficient knowledge in the topics of climate change and sustainability. The environmental educator also pointed out the system had a lack of practical support, such as guidelines and materials, for teachers to promote climate education in schools and a lack of quality assurance on the climate education outcome.

Although the terms "sustainability", "sustainable way of living" and "ecosocial knowledge and ability" are consistently stated in the national core curriculum, the curriculum does not provide a clear definition of these terms or instructions for teachers to achieve these goals. In my perspective, the future image illustrated by FNBE appears to be vague and broad. At one point, I capture an impression that the curriculum has left the main responsibility to teachers to "guide the pupils in adopting a sustainable way of living". As a result, teachers may find it difficult or even helpless to adapt the curriculum reform without a clear definition of the concept, relevant instruction or material support. These challenges identified can also be seen as intervention opportunities for this thesis. Therefore, one of the aims for this new playset is to support teachers experiment MLs and phenomenon-based learning, thus promoting education for sustainability.

To sum up this sub-chapter, I analyse the key values of the

new Finnish national core curriculum in terms of education for sustainability, by assessing it against the EarthCore from the Worldwatch Institute. The model EarthCore is used as a key reference in this thesis as it provides a comprehensive sum of elements that promote education for sustainability. In general, these two models have a number of similarities in their emphasis and key values. Finnish curriculum seems to illustrate the role of sustainability as an important element in students' learning and part of the future vision. The curriculum encourages teachers to guide students building sustainable ways of living and future. However, my study also identifies several challenges in terms of practical execution of the new multi-disciplinary curriculum transition, including teachers' struggles in implementation MLs and the lack of supporting materials. These challenges are also seen as the opportunities that this design outcome can intervene, in order to contribute to the Finnish education reform.

2.4 Play in a Finnish kindergarten

The previous analysis shows Finnish education emphasizes play as the main learning method and the importance to provide children with different kinds of play opportunities. Apart from analysing the top-down curriculum, I also study the role of play empirically in a Finnish school context and identify relevant elements for the playset development. I collected stakeholders' perspective on play through interviews and observed a kindergarten morning session as my main first-hand data to understand the play practice in local schools.

In Finland, children start formal schooling, basic education, at the age of seven. Before seven, children mainly attend play-based education in kindergartens. From interviews, the interviewees repeatedly emphasized the values of play in early childhood education. "*If I think children under seven years old... it[play] is the main thing to do. The kids learn with play*", a kindergarten teacher expressed her perspective on children's play in the interview. Three other early childhood educators also agreed on play as the key and heart of learning in Finnish education. One of them explained Finnish generally valued young children's play and curiosity with less responsibility as a good childhood;

children were encouraged to freely wander around and learn things interested them.

Observation in a kindergarten

The kindergarten observation provided me a deeper understanding of the play practice in the classroom. The kindergarten is located in the area Kontula, Helsinki. The school had two mix-aged grades, one for age under three, the other for age between three to five. My observation focused on a class of twenty-one children, between the age of three to five. According to the curriculum requirement of one adult versus seven children, this class had three adults, one teacher and two nurses, to take care of the children. Mostly, children were organized into small groups (between five to ten children per group) for different indoor and outdoor activities, thus optimizing the discipline and space utilization. This class had a relatively flexible schedule; the teacher usually planned activities for the morning session and reserved the afternoon session for naps and free play. The school also emphasized project-based learning; a theme usually lasted for five weeks and children spent one to two days per week to do relevant activities. During my visit, the theme was "pirates"; the interior was decorated accordingly, and children were dressed up with small accessories, such as scarves and stickers on faces.

From the observation, I identified three key elements as important inspiration and consideration for the new playset design. The three elements are:

- Child-centric play
- Outdoor experience
- Stories as instruments

Child-centric play

As mentioned before, child-centricity seems to be valued in Finnish education; children's interest is one main consideration and they are engaged in decision making about their daily activities. "*Usually, we [children and the teachers] make the decision together about what they are going to do and play*" the kindergarten teacher pointed out most of the children knew what they wanted to play, and teachers would usually consider their will and interest. *Image 2* shows an information wall for morning circle, which is a morning activity for children and teachers to discuss

together the daily activity arrangement. Apart from this, other educators also highlighted this concept and the practice of harnessing children's curiosity for further learning activities. For example, students raised up their recent interest in the topic of "ghosts". Teachers would try to create playful learning activities under this theme. This idea of child-centric play seems to value children's self-exploration and curiosity as the core learning motive. In my perspective, this classroom practice of child engagement in decision making demonstrates democratic values and provides opportunities for children's participation as part of the community.

Image 2. An information wall for morning circle in the kindergarten classroom.

Outdoor experience

As mentioned earlier, the direct nature-based experience is valued. The kindergarten teacher reflected children would go outdoors every day in any weather conditions, usually at least one hour. Children usually played freely in the school backyard and sometimes had arranged activities with teachers, such as walking in the woods nearby. Besides, other educators also agreed that direct nature-based experience was one of the most efficient ways for children to learn about sustainability through playing and wondering about natural phenomenon. One educator acknowledged the importance of nature and its sustainability as both national income and wellbeing in the Finnish culture, thence emphasizing children's relationship and appreciation of the Finnish nature. Therefore, the playset design should include children's outdoor exploration as one of the criteria.

Stories as instruments

The last element is the role of stories in the classroom. Stories are considered as important instruments for children to perceive the world. During my visit, I realized the strong engagement of children in stories and make-believe play in daily activities, for example, the five-week theme pirates. Children understood the symbolic meanings of certain gestures or behaviours and expressed their imagination through role-playing. In this context, the story becomes a starting point for children's imagination and creativity. Another element caught my attention was children's

curiosity in mysterious illustration. During a story-telling session, children carefully observed the illustrations and consistently asked questions about the unidentified details. They found those details interesting and led to joy and laughter. This observation inspires me to embed mysterious elements in the playset story and activities to attract children's interest and spark their imagination.

From the analysis above, I empirically examine the role of play in Finnish classrooms. Through the kindergarten observation and interviewing educators and teachers, I identified three key elements to embed into the playset design criteria. The elements are child-centric play, outdoor experience and stories as instruments. This analysis provides a basic understanding of how the playful learning materials can be used in classrooms. Chapter 5 and 6 will explain further how these findings are embedded into the design.

3 Methodologies

3
Methodologies

In this chapter, I am going to indicate the structure and methodologies of this thesis. In general, this explorative study is under the structure of Double Diamond as the creative design process. With the collaboration with Playful Learning Centre (PLC) in University of Helsinki, I look into the role of play in promoting sustainability across perspectives of design, education and sustainability. In the following, I am going to describe in details of the methodologies of this study, including theoretical and empirical data collection, user involvements, design process and design thinking and the nature of trans-disciplinary design research.

3.1 Collaboration with Playful Learning Centre

As mentioned in the background chapter, this thesis is a collaborative project with Playful Learning Centre (PLC) in Faculty of Educational Sciences, University of Helsinki. PLC is a research lab focuses on researching the role of playful learning in early childhood education and develops diverse projects, such as pedagogical models, learning

Image 3. Logo of Playful Learning Centre (Playful Learning Centre, n.d.)

Image 4. Logo of MOI program (Monilukutaito, 2017a)

environments and materials. The lab argues that playful learning experience provides a strong foundation for children's future learning at schools, well-being, citizenship, working life and adulthood. Its research mainly focuses on children under the age of eight. The lab, established in 2014, locates on the City Centre Campus in the heart of Helsinki (Playful Learning Centre, n.d.).

The project Whisper of the Spirit (Erfving et al., 2017) is developed under the Joy of Learning Multiliteracies (MOI) research and development programme in PLC. The MOI program, which is funded by the Ministry of Education and Culture aims to promote multiliteracy in early childhood (Monilukutaito, 2017a). Under this program, the collection of activity cards Whisper of the Spirits is developed to promote Finnish ancient beliefs about nature, as well as enhancing children's competences in multiliteracy. The package of cards is available online as creative commons for non-commercial purposes use (Monilukutaito, 2017b).

The following *Figure 4* is the stakeholder map of this collaborative project and shows briefly the relationship and flow of resources. In the January 2018, this project was started by me, as the CS master student, contacting PLC for

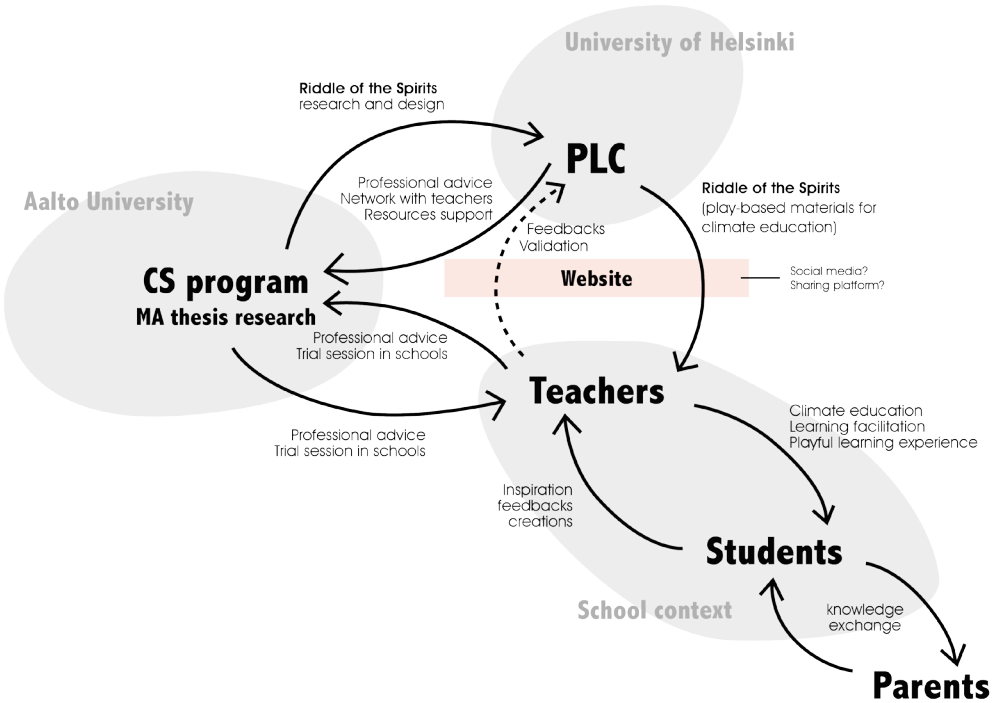


Figure 4. The stakeholder map of this thesis Riddle of the Spirit

a design research collaborative opportunity. PLC showed interest and suggested to extend its existing project, Whisper of the Spirit, as a starting point. Therefore, I identified it as an intervention opportunity to promote education for sustainability with storyline and characters established.

During the design process, I, as the designer, was the active actor and PLC supported the playset development by providing various resources, including professional advice, interview opportunities, network with local teachers, workshop venue and materials. In return, this project offered PLC the playset design Riddle of the Spirit as the main outcome, user involvement opportunities and insights from design discipline. Through the network of PLC, I had the chance to work with a kindergarten in Helsinki and a primary school in Espoo for interviews, observation and prototype trial. Teachers also provided valuable insights as users on a practical level. In turns, this project provided teachers with the playset prototype materials, activities content and a playful learning experience for children in the trial session. This collaboration was significant in this study as it provides me valuable research resources and a practical opportunity to develop playful learning materials. It made the research process smoother and easier, particularly in data collection and stakeholder engagement.

3.2 Design process & design thinking

The creative process of Riddle of the Spirit is basically developed from the Double Diamond model mapped out by Design Council (2017). The model visually presents a way of thinking and working commonly used by designers. The shape of diamond represents the combination of "divergent thinking" and "convergent thinking" process. The first diamond refers to the phase of problem definition before the design brief, which involves "discover insight into the problem" and "define the area to focus upon". Then, the second diamond refers to the phase of "develop potential solutions" and "deliver solutions that work". Applying the Double Diamond model, I implemented a triple diamond in this study, which a third diamond phase happened between two prototype evaluations. *Figure 5* shows the timeline of the triple diamond structure. The design process lasted about five months, between the beginning of January 2018

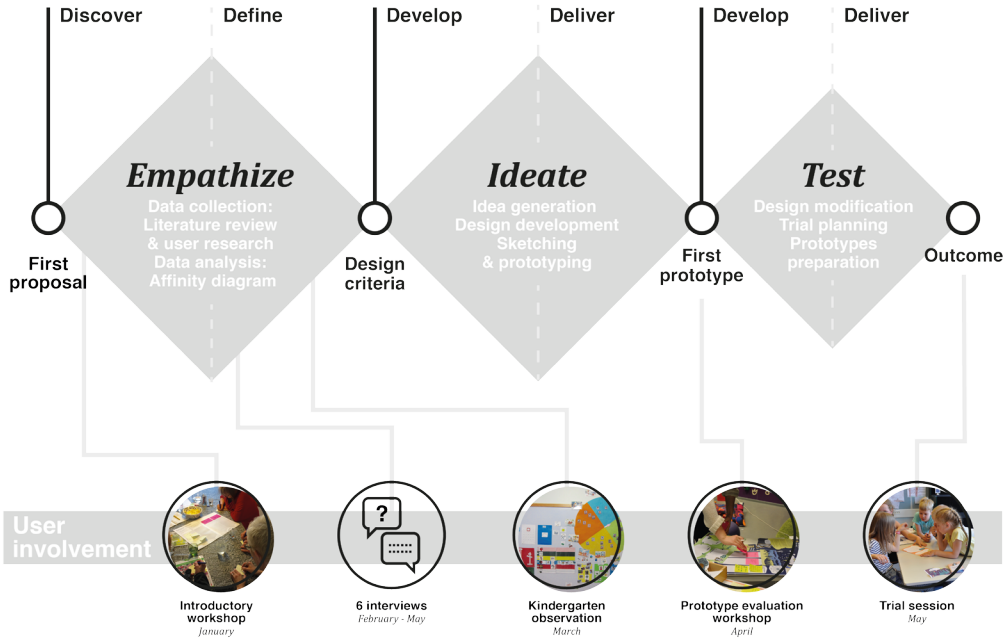


Figure 5. The Triple Diamond model structure and user involvement methods of the playset design process (Design Council, 2017)

to the end of May 2018.

The process presented in the diagram consists of four key checkpoints and three phases. The first proposal was made in January 2018 to start the process. Afterward, the first phase, which I called "empathize", was to understand the context and identify requirements and limitations before defining the design criteria. In order to do so, I carried out a number of theoretical and empirical research. Theoretical research includes literature reviews mainly in areas of education for sustainability, Finnish education and its curriculum, pedagogical theories of playful learning, play design and design research. Empirical research includes an introductory workshop with parents and children, six interviews with three early childhood educators, one designer, one kindergarten teacher and one environmental educator, and one kindergarten observation. These user research methods will be further described later. After that, I generated the design criteria, which is a list of key contextual factors, user expectations and limitations based on the data analysed from the phase "emphasize". Defining design criteria is the second key checkpoint and acts as

the guideline for ideation and development in the second phase "ideate". During ideation, a number of ideas for the playset were generated through sketches and quick model-making (*Image 5*). After a period of development, the playset structure and a set of seven activities were firstly prototyped for the third checkpoint prototype evaluation workshop. The workshop aimed to collect comments from relevant stakeholders for validation and improvement suggestions. Based on the workshop comments, a third phase "test" was carried out to modify the first prototype and produce the second prototype for the last checkpoint trial session. This trial session was the final validation of the playset design with teachers and children in the classroom context. The data collected from the trial session will be discussed in Chapter 5. *Figure 6* illustrates the general structure and data flow of the design process. However, in fact, the process was not as linear as illustrated; each phase and checkpoint involve constant reflection and revision. For example, the ideation process was started earlier during the period of data collection and analysis. And I constantly revised the design criteria once I collected new relevant data. I summarize the process in a linear format for clear interpretation.

Image 5. Samples of sketches and quick model-making in the ideation process

According to IDEO (n.d.), design thinking refers to a process for creative problem solving with three essential aspects: empathy, ideation and experimentation. These three

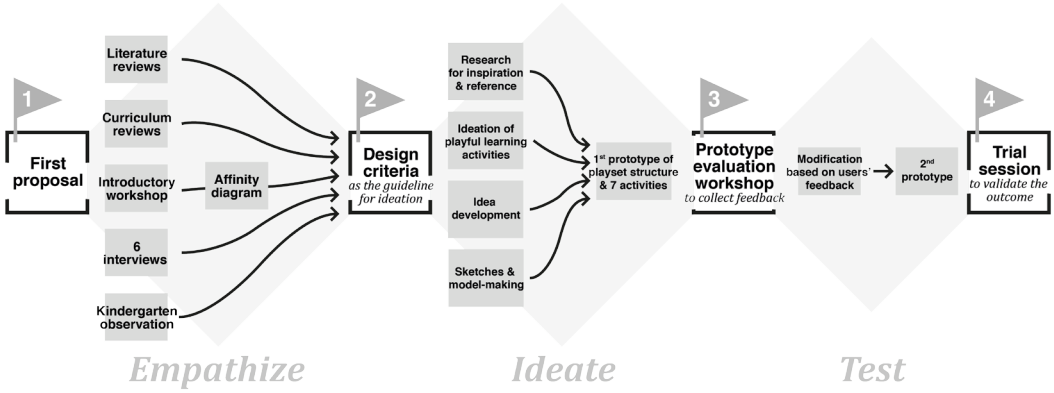


Figure 6. The data flow in the design process

aspects altogether played an important role in this thesis. Firstly, empathy was the key for me to understand the context and create a human-centred design. To achieve this, I have conducted a series of user research activities, which will be further described in the following sub-chapter. Secondly, with my toy design experience and background, I generated a great number of ideas through sketching and quick mock-ups and constantly showed the ideas to interviewees for insights and inspirations. Lastly, in my perspective, the values of experimentation weights in the thesis purpose of promoting sustainability through stories and play, as well as the outcome of pedagogical framework and playset developed.

Referring to Dan Formosa (2012), a Ph.D. scholar designer, he pointed out design thinking as a new problem-solving approach relying on research and innovation used in new product and services development. As he stated, innovation referred to a new and unique way of thinking, did not necessarily mean invention. In this experimental study, applying design thinking supports me to create the outcome in harmony between the play values of activities, the learning goals of education for sustainability, the context of Finnish education and users' expectation. Innovative values weights on the playset design, application of trans-disciplinary design approach and the theoretical framework of the design outcome, which aims to connect the real-world climate issues to children' daily observation and behaviours through stories.

3.3 User research & involvement

During the design process, I conducted five key user research methods to involve relevant stakeholders to ensure the usability of playset outcome. The methods were: an introductory workshop, six interviews, a kindergarten observation, a prototype evaluation workshop and a trial session. *Figure 5*, mentioned previously, shows the corresponding phase where these methods were carried out. In the following, I will briefly describe the method application, data collection and analysis.

Introductory workshop

The introductory workshop was conducted in the very

beginning of the design process as background research. The workshop aimed to understand parents' concerns about their children in the urbanized childhood and children's definition of play. Total ten participants include four parents, one teacher and five children (aged between eleven to thirteen), which adults and children were separated into two groups for different activities. The data collected did not directly link to the playset design development. However, it was an inspiring introductory research for me to understand children' and parents' perspective on play and child development in Finland. It was also a good opportunity to practise my workshop organization and facilitation skills. In terms of documentation, research consent letters for data and photograph agreement were signed by participants and children's parents before the workshop. *Image 6* and *Image 7* give a brief idea about the workshop.

Image 6. Children's group in the introductory workshop – reimagine a play kingdom with no commercial products

Image 7. Parents' group in the introductory workshop – discussion on parental concern of children's lifestyle

Interviews

Among the methods, the interviews were the most informative user research and formed the major foundation of criteria. The six interviewees include three educators from University of Helsinki (one professor, one adjunct professor and one Ph.D. researcher), one environmental educator, one designer/artist and one kindergarten teacher. During the interviews, I focused on gathering interviewee's perspective on the role of play and sustainability in Finnish education, their feedback on the existing project Whisper of the Spirits and their expectations on the new project Riddle of the Spirit. Data collected from interviews was written into single data form from the audio format, clustered into groups based on similarities and analysed by the method affinity diagram (Lucero, 2015), which *Appendix 1* shows a sample of this analysis. In the affinity diagram, user concerns and expectations on the design outcome were identified to become part of the criteria.

A kindergarten observation

The kindergarten observation with an interview with the kindergarten teacher provided me a general understanding

of the role of play in Finnish early childhood education. During the observation, I looked into several aspects; the school setting and learning environment, classroom structure, schedule, the interaction between children themselves and with teachers, children's interest and curiosity. I focused on observing classroom daily routines to identify possibility and potential limitations for using the playset, such as preparation, activities. Also, I paid attention to elements that would interest children as inspirations for the new playset. The findings of this observation mainly relied on my own notes and the interview audio of the kindergarten teacher. Since there was no parental consent agreement with the children, no photos of children will be shown in this study. The observation findings are narrated in sub-chapter 2.4.

A prototype evaluation workshop

After the first prototype was made, an evaluation workshop was conducted to collect feedback from relevant stakeholders on the playset design against the criteria established. The workshop was organized in the PLC lab with nine participants, four educators from PLC, two designers/artists, two primary-school teachers (first and second grade) and one CS student. After warming up with a playful activity, we had three activities in total. First of all, participants freely explored the seven playset activities, including instruction and props. Secondly, participants formed into two groups to evaluate the playset by following a template of design criteria. Finally, we completed the workshop with a discussion on the values of this design in the Finnish education and expectations in further development.

The workshop was an effective checkpoint in the design process. The majority of feedback was positive and encouraging; participants generally agreed with the aims, structure and activity design of the playset. Their improvement suggestions focused on the application and usability at the practical level. The key suggestions included: less directing questions but more imaginative open-ended questions; the use of child-friendly text; minimizing materials preparation required. To me, the findings were valuable as some concerns raised up were unconsidered. Also, teachers provided an important recap of the classroom situation, children's learning ability and their daily routines. For documentation, a consent letter was signed by each participant and

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10	11

Image 8. A short presentation of playset design
Image 9. Playset prototypes and participants' comments in sticky notes
Image 10. Participants explore and discuss the design
Image 11. Group evaluation on the design by following a template of criteria.

Image 8 to *Image 11* are the workshop situation.

A trial session with children

The trial session was the last checkpoint of the entire design process. Two primary-school teachers participated in the prototype evaluation workshop agreed to test the playset in their classes. Then, the trial session was carried out with 37 students for two-morning sessions in Espoo. Before the session, I have submitted a research permit to the city of Espoo in order to collect data in the school. Also, a *Parental Permission for Participation of a Child* (shown as *Appendix 2*) has been given to each student in advance to collect the agreement for photographs and video taking. After that, teachers and I organized the 19 children with permission to photograph into one class and the rest into another class for effective documentation. The findings of the workshop are mainly analysed from the photographs, videos, children and teacher's feedback and my notes of observation.

The result was a positive validation of the playset design.

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Image 12. Children's free exploration with role-play props in outdoor
Image 13. The class discussion about concepts of global warming after activities

Teachers agreed that the material assisted their teaching and successfully provided a playful learning experience to children, as well as introducing the topic of climate change through the story and "spirit" characters inspired by Finnish myths. *Image 12* and *Image 13* show two of the seven activities during the session. The process and findings will be narrated in-depth in Chapter 5.

3.4 Trans-disciplinary design research

Design research – design as a way of researching

In the paper *Designerly Ways of Knowing*, the design educator Nigel Cross (1982) further defined the argument, established by Bruce Archer (1979), of the design discipline as a "third area" of education after sciences and humanities. Cross highlighted design as a way of knowing, particularly referring to the artificial world through methods such as modelling and pattern-formation. He identified five key aspects of this discipline, including the ability of designers

to tackle "ill-defined" problems, "solution-focused" problem-solving skills and the competence of translating abstract requirements into concrete objects.

The main outcome of this exploratory study is the playset design Riddle of the Spirit. Throughout the design process, abstract requirements are collected and identified as design criteria and translated into a concrete applicable playset for the Finnish school context. In fact, the set of design criteria is another significant output of this thesis, as a guideline to design applicable playful learning materials for Finnish education. This thesis applies the Research through Design practice (Frayling, 1994), which refers to an inquiry approach of gaining unique insights through design practice to better understand the context. This approach allows this study to acquire an in-depth data about the role of sustainability and play in the Finnish new curriculum reform, and further research opportunities.

Trans-disciplinary design research

According to Gjoko Muratovski (2016), who has conducted profound studies in Design Research, there is a rise in cross-disciplinary design research due to the circumstances of increasingly complex global issues. These global issues, such as climate change and globalization, demand new solutions and new approaches to tackle. This deeply impacts the field of design and creates a shift of designers' profession from providing artistic services to professional "thinkers" who can work across disciplines. It demands designers to have other capabilities and leads to the cross-disciplinary model of design education and research.

My thesis is conducted in a transdisciplinary way of working, which refers to my active role and adaptation of working approaches from other disciplines (Lawrence & Després, 2004). The main purpose of this thesis is to promote education for sustainability in early childhood through playful learning design as an intervention. In order to do so, knowledge from three different areas is required in the research process. The areas are education, sustainable and design (*Figure 7*). As a CS student with a designer background, I have experience in design process and basic knowledge in sustainability development. Building on top of this, I identified the necessity to work with partners in the education field to investigate this topic; for this reason,

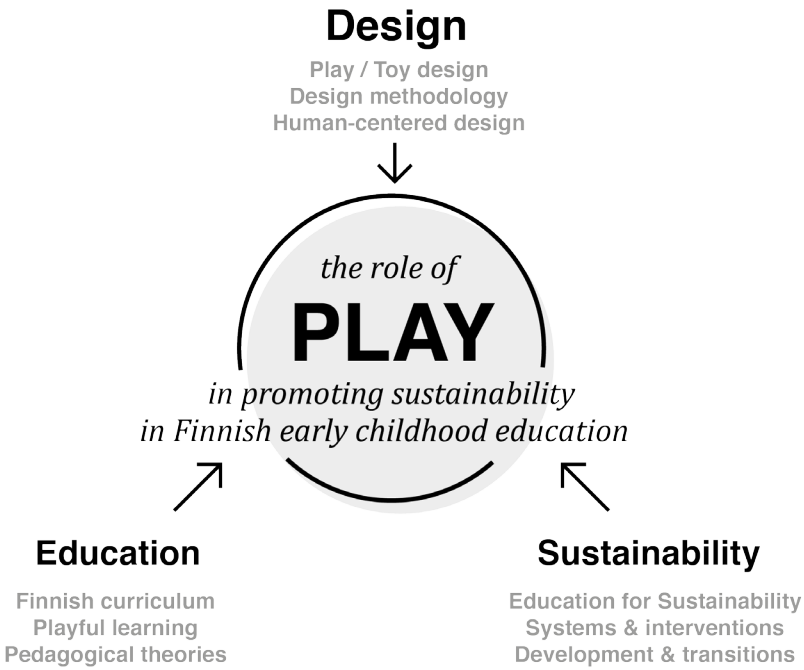


Figure 7. Trans-disciplinary design research across education, design and sustainability

I approached PLC and proposed a collaborative design project. I spent a significant amount of time on studying relevant information in the field of education, particularly early childhood education, the Finnish education system, pedagogical theories in playful learning and education for sustainability. Apart from this, professional advice from educators and teachers also guide me to understand deeper the topics. With the integration of knowledge from multiple disciplines, I was able to understand better the education context, identify the needs and behaviours of users, create the criteria and pedagogical framework for the playset design. In other words, I researched and worked in a new and experimental way to address the research question. The two main motives of the trans-disciplinary design research model are the pursuit of applicable results and the search for inspiration in new research questions, methods and conceptual frameworks (Aagaard-Hansen, 2007). This research approach benefits to developing an applicable playset design for the classroom context. Besides, the design process also inspired and revealed more users' demands for further research and design development, which will be deliberated in Chapter 6 *Discussion*.

Qualitative research and human-centred design

In order to design an applicable playset, the process required a rich understanding of the situation and human behaviours. Therefore, I adopted the methodologies of qualitative research and human-centred design. Qualitative research, for example, the analysis of Finnish curriculum and play practice allowed me to further investigate the worldviews of relevant stakeholders, gain new insights about the school context and develop the theoretical framework for the design process. Referring to the Codesign Journey Planner developed by INUSE research group (2015) of my university, human-centred design defines as "*giving the needs, wants and limitations of end users of a product, service or process extensive attention at each stage of the design process*". In the design process of this thesis, users have been involved constantly in nearly every checkpoint as previously mentioned.

4 Play & Design

4

Play & design

This chapter focuses on the connection between play and design practice in this study. This part is written based on the literature review and empirical study and my seven-year experience of toy designer and play design researcher. Firstly, I am going to start with a brief historical overview of play theories, including its definition and classification. Secondly, I will explore the idea of meaningful play and the role of design as playful learning design in this study. Lastly, I am going to reflect on and examine the values of play in design practice.

4.1 What is play?

What is play actually? And what is it for? Plentiful and profound researches have been undertaken to define the nature of play and its functions. These researches appeared mostly in the disciplines of education, psychology and social science. In fact, according to one important study The *Ambiguity of Play* (1997), Brian Sutton-Smith described people tend to use this term to cover various activities; the concept of play was difficult to distinguish from other forms

of behaviours. The definition of play varies according to context, interaction and individuals' values. For example, during the introductory workshop of this thesis, children and parents tended to associate "play" with "fun" and activities they enjoyed doing, such as sports, music, socializing, art and craft. Each person defined the concept of play in his/her own way. Therefore, there is a considerable difficulty to establish a collective definition of play due to its complexity.

Various theorists attempted to categorize the nature of play and proposed different frameworks. I found them valuable, as each revealed something more about this phenomenon. Among the play theories, I would like to refer to an influential scholar Johan Huizinga and his ground-breaking work *Homo Ludens* (1938), "Man the Player" in Latin words, which is a classic evaluation of play elements in culture and societies. This landmark study has influenced several significant play and game studies; at the same time, the work received a number of challenges and criticism. In his work, Huizinga described play as free and meaningful; distinct from "ordinary" life; and occurred for its own sake with no material or profit interest. Building on top of Huizinga's point of view, another important scholar Roger Caillois (1962) proposed a framework to fundamentally classify play activities. This framework included four categories: *agôn* (competitive play), *alea* (chance-based play), *mimicry* (make-believe play) and *ilinx* (physical stimulation of vertigo). And these categories can be examined with a spectrum from *ludus* (ruled play) to *paida* (free play). These two and some other theories built a basis for further play discourse and researches in the late twentieth and twenty-first century.

What benefits does play provide? Although the exact nature of play is still debatable, it has been proved to have diverse functions and significant benefits to human learning and development, especially children's. In one study *Learning through Play*, Peter K. Smith & Anthony Pellegrini (2013) reviewed the main types of play and its developmental benefits in different age grade of children. The benefits can be provided across the play types and the following only showed a general outline. The followings are selected play types outlined:

- *locomotor play* (exercise play) for physical coordination and healthy growth;
- *social play* for social and emotional coordination skills development;
- *object play* for experimental manipulation and problem-solving skills; and
- *pretend play* for story-creation, pre-literacy development and emotional security.

The authors also emphasized a balanced approach between diverse play types could optimize the educational values to children. And the role of adults, as play tutors, were important to achieve balanced play experience with suitable instruction, toys, props, and environment setting.

4.2 Playful learning design

Play has been proved to provide significant developmental benefits to children through different forms and context. And one of the studies also reminded us of the role of play tutors would be important to provide a structure of the playful learning experience to enhance the learning values. In this context, what is the role of design and its contribution? In the following, I am going to explore how design can applied to construct the children's play experience and achieve "meaningful play".

"*All play means something*" stated by Huizinga to argue the significance of play in his work Homo Ludens (1938, p.1). He also emphasized that there was "sense" to play and "*which transcends the immediate needs of life and imparts meaning to the action*" (1938, p.1). In fact, these statements are relatively complex and they can be understood in multiple ways. In the work *Rules of Play*, game-design educators Katie Salen and Eric Zimmerman (2004) explored further the concept of "meaningful play" by building on top of Huizinga's statement. Although these two authors focused on the context of game design, their theory appeared to be applicable to other play-related contexts. They attempted to identify the intimate relationship between the concepts of meaning, play and game. And they proposed "*meaningful play occurs when the relationships between actions and outcomes in a game are both discernable and integrated into the larger context of the game*" (2004, p. 34). In this

definition, “discernable” refers to a game allowing the player to perceive the immediate outcome of an action; “integrated” refers to the outcome of an action woven into the game system as a whole. In my understanding, for example in a playset of seven activities, meaningful play occurs when each activity and the integration of the entire play experience both bring learning values to children.

So, what is the role of design in the meaningful play discussed above? First of all, I would have to explore the connection between design and meaning. In fact, the word “design” itself shows the nature of this practice. From the perspective of etymology, *design* is from the Latin *de + signare*, which means “*making something and distinguishing it by a sign, giving it significance, designating its relation to other things, owners, users, or gods*” (Krippendorff, p. 9); design is making sense (of things). Back to the game-design reference, Salen and Zimmerman (2004) gave a general definition of design to describe its connection to meaning; the definition is “*design is the process by which a designer creates a context to be encountered by a participant, from which meaning emerges*” (2004, p.41). To discuss further, the two authors also drew attention to the concept of semiotics, which is seen as an important study in the design discipline. Generally, semiotics refers to the study of meaning-making and representation of signs. Likewise, in the design discipline, it is vital for designers to understand the meaning of signs to somebody in order to make sense of things and create a context. In other words, design is basically a practice of understanding the meaning of signs and constructing the signs into a purposeful context.

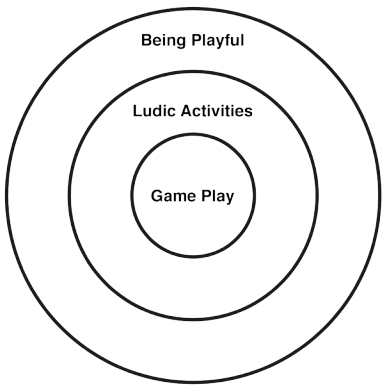


Figure 8. Three categories of play (Salen & Zimmerman, 2004, p.304)

Before defining the nature of playful learning design in this study, I would like to reference a design-centric definition of play by Salen and Zimmerman (2004). The authors defined “*play is free movement within a more rigid structure*” (2004, p.304) and provided a diagram, *Figure 8*, to illustrate the idea of play in structure. The diagram indicates the open and inclusive relationship of the three categories. The broadest circle *being playful* refers to the playful state of mind, not only playful activities, for example, making

simple jokes or creating funny rhymes with words. The middle circle *ludic activities* (ludic as relating to play in Latin), refers to play activities including both games and non-game behaviours, such as children playing swings and slides in playgrounds. Lastly, the smallest circle *game play* refers to the formalized interaction of players within the rules and its system. In another interpretation of this diagram, game play would be a kind of more formalized ludic activity; ludic activity would be a more formalized way of being playful. Building on top of this definition, design for meaningful play would mean making this free movement meaningful by creating the rigid structure.

After exploring the relationship between design, play and meaning from the above theories, I would like to define the nature of playful learning design in this thesis as:

a process by which a designer creates an appropriate rigid structure of enjoyable and meaningful play for children to achieve pre-determined learning goals.

In order to do so, the designer, myself, has to understand the play values, the meaning of playful actions, its outcome and define the learning goals. This process also requires designer's competence of creating a play context with embedded educational values to influence children's playing behaviours purposefully. In relation to my playset design Riddle of the Spirit, the learning goals were set by summarizing the values of EarthCore principles, Finnish curriculum and the interviewees' expectations. In this thesis, the role of playful learning design would refer to the process which I (as a designer) create a playful context with instructions, props and storyline (as the rigid structure) to be adopted and experienced by children and teachers, from which learning outcome (as meaning) emerges. I believe the learning outcome would be children's acquirement of knowledge, skills and enjoyable experience from the play. In this case, the *discernable* meaning would refer to outcome children obtained from each activity and the *integrated* meaning would refer to the accumulated outcome of all activities of the whole play experience. To explain further, *Figure 9*, as my interpretation of playful learning design based on theories discussed previously, which I believe the scale of *ludus* (ruled play) and *paida* (free play) stated by Caillois (1962) can indicate the connection between the

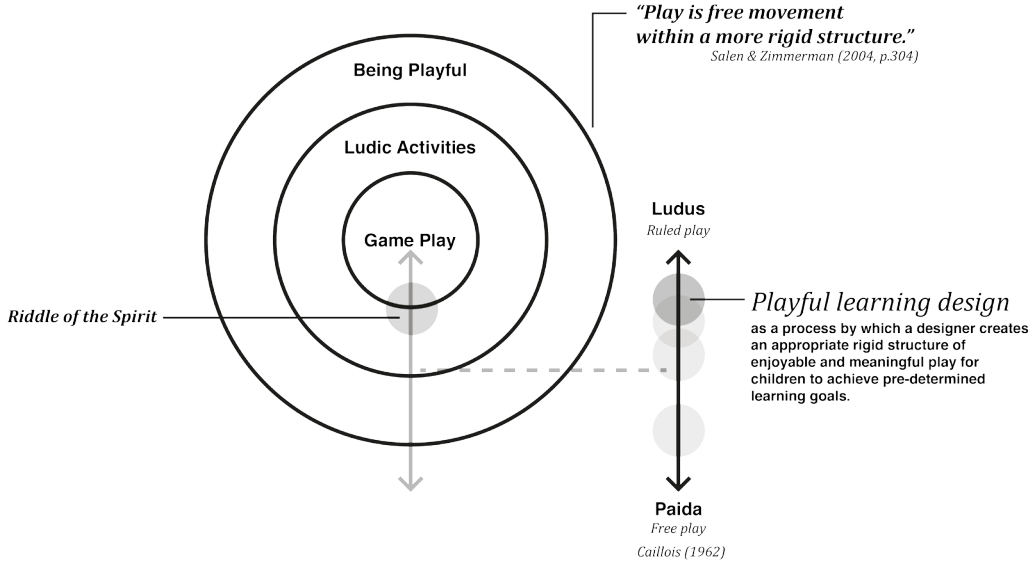


Figure 9. My interpretation of playful learning design based on theories of Caillois (1962) and Salen & Zimmerman (2004)

three play categories purposed by Salen & Zimmerman (2004). In my perspective, my role as the designer was to identify an appropriate location on the scale of *ludus* and *paida* and on the three categories of play by creating a rigid structure. In this definition, "appropriate" refers to the self-confidence of designers in the decision-making of acceptable solutions, which is described by Cross (1982) as one of the values in design culture.

In *Figure 9*, I position this thesis outcome Riddle of the Spirit overlapping the categories ludic activities and game play. As the playset consists of seven activities and each has its own play nature and instruction, some are more game-liked with rules and some acts as props with flexible applications. For example, activity 1 *Ask the Spirit* and activity 4 *Spirit Tower* have a clear flow for children to follow in order to achieve the goals; whereas, for instance, activity 2 *Through Spirits' Eyes* remains open-ended for children to play by interacting with the role-play accessories.

The discussion above is to indicate my understanding of design in this playful learning material development. In fact, there are other terms used to describe similar areas,

for example, playful design, design for play. However, I would prefer to use the term playful learning design as the nature of design practice in this thesis. In my perspective, playful learning design is under the larger umbrella of play design. And the key distinction of this term from play design is the clearly defined learning goals as the outcome of the meaning play. And the application of playful learning design will be mainly for pedagogical purposes. This term can also be used to refer to all kind of design practice relevant to playful learning, including toy, game, children furniture, interior, playground, children's illustration, books and character design.

4.3 The values of play in design practice

As a play designer, I realize the close connection between play and design during the design process. Therefore, I would like to explore how these two practices have influenced and brought each other values in this thesis. As previously discussed, design, as a practice and process, can be used to create a meaningful play context by constructing playful actions and its outcome. However, what values do the practice of play bring to design?

In my perspective, play can enhance designers' multiple competences. As it inspires creativity, imagination and new perception about the world, as well as enhancing problem-solving skills, empathy and confidence in make-believe. Referring to the discussion about design thinking earlier in sub-chapter 3.2, there are three significant aspects in the design process, which are empathy, ideation and experimentation (IDEO, n.d.). To me, play is self-exploration, expression, a mindset of experimentation, as well as a way of thinking, such as so-called "playful thinking". This practice benefits me in different ways to achieve these three aspects in the design process. As some may define play as activities not consciously performed for any results. To me, this mindset encourages random experimental exploration, which stimulates creativity and inspires new ideas. For example, in the phase "ideate", simply being playful as a state of mind allows me to think creatively and generate more ideas, such as experimentally

combining play elements to generate new playful activities.

In fact, I believe play and design have several similarities in their nature. The idea of play is often appeared in design activities, especially as research methods in human-centred design. For example, in the field of service design, role-play is often used as a tool for designers to understand how users would behave with existing or new service in the real situation (Tassi, 2009). The process of role-play allows designers and stakeholders to increase empathy, visualize the abstract concept into scenarios. Another example is the increasing application of "design games" in co-design discussed by Kirsikka Vaajakallio & Tuuli Mattelmäki (2014). They believed the use of games, as a playful mindset and a structure, enhanced idea generation, atmosphere and stakeholder engagement in co-design activities. Designed materials, such as cards, board games, role-play props were often used to enhance the play experience. The authors also suggested that play could assist players to think beyond the current moment, recall past memories and imagine future dreams. Their study acknowledged the values of play in the design process and activities.

Referring to one of Huizinga's (1938) point about play as not "ordinary" or "real" life, indeed, I believe that play acts as a bridge to connect imagination and reality. For example, during pretend play, players identify the social norms and representative meanings of elements and interpret with stories and characters created in their own ways. Through play, as an imaginative practice, players build abstract

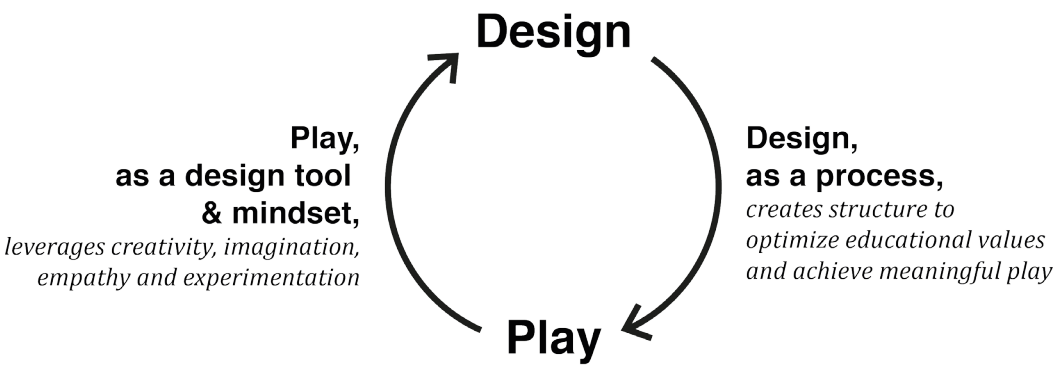


Figure 10. Values of play and design to each other in this thesis

creations on top of realistic scenarios. Whereas in a practical level, design often requires strong imagination of designers to define complex problems by thinking beyond visible and create innovative feasible solutions in a realistic setting.

To me, as a play designer, play and design are interconnected; these two practices foster each other. In this thesis, play, as a tool and mindset, enhances my design competences of divergent thinking, creative thinking, imagination and experimentation. Simultaneously, I apply the competences and create a structure to achieve meaningful play as the outcome, referring to *Figure 10*.

5

Riddle of the Spirit – Framework &Outcome

5

Riddle of the Spirit – Framework & Outcome

The playset Riddle of the Spirit is the main creative outcome of this thesis. This chapter will present the theoretical framework developed and the playset in details. First, I will start the playset aims and story background. Then, I will discuss the pedagogical framework, which is developed as an approach to constructing the play experience. The design criteria will be shown as an ideation and development guideline based on the key findings identified previously. After that, the playset structure and activities will be described in detail with the results of the trial session in a classroom setting. Finally, I will conclude with the feedback and discussion from the participants, teachers and students.

5.1 Aims of the playset

I would like to start with the PLC existing project Whisper of the Spirit (Whisper) (Erfving et al., 2017). Whisper is developed under the MOI program by a team of three PLC educators and two designers/artists (see above sub-chapter 3.1). It is a collection of 14 activities aiming to promote children's

(under eight years old) multiliteracy competences and raise interest in Finnish myths about nature. The team identified the "spirit" characters from Finnish myths and brought them alive with illustrations, descriptions of their characteristics and the activities. Each activity combines simple instruction with Finnish-myth-related story background. For instance, the activity "Tapio's Kingdom" introduces the "forest spirit" Tapio and leads children to perceive and describe the experience of walking in a forest through five senses. The set attempts to stimulate children imagination by using creative open-ended questions, such as "*what would a spirit's home look like*" (Erfving et al., 2017, p.6), "*if you were a bear, what kind of forest would you like to live in and what would you like to do*" (Erfving et al., 2017, p.8). The activity also guides children to imagine based on their daily experience as starting point, such as an instruction "*take a close look at the stones and trees in the school playground: can you see a fairy, an elf or a troll anywhere*"(Erfving et al., 2017, p.5). The set provides diverse activities to motivate children to go outdoor, explore natural phenomenon and imagine the "spirit" story. Teachers can freely download this material from the MOI website and apply in their own

Figure 11. Selected cards from Whisper of the Spirit (Erfving et al., 2017)

ways. The team pointed out this project has received a great amount of positive feedback, mainly about the beautiful illustrations, flexible application of activities and the leverage of Finnish myths, which seemed to be forgotten by the general public. *Figure 11* shows some selected cards from the collection.

As the designer, I focused on how this story background and "spirit" characters can be utilized in creating a meaningful play experience for children to learn about climate issues. Therefore, the new playset Riddle of the Spirit (Riddle) aims to promote environmental awareness, relevant knowledge and skills, as well as enriching the play values. The overall aim of Riddle is

to connect students and their daily experience to the climate issues through story and play, thus enhancing their sense of responsibility to nature.

To achieve this, the playset has to be able to provide content knowledge about the climate issue and allow children to explore their own connection with the issues. And the next sub-chapter will show the pedagogical framework, which is established as an approach to achieve this aim. *Figure 12* shows the four main characters of Whisper who lead the story of Riddle. These four characters are used as the instrument to guide children to study the topic.

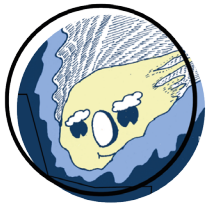
5.2 Pedagogical framework

In this study, three pedagogical theories are referenced as the methods to deliver the learning values to achieve the aim outlined previously. The theories are *purposefully framed play* (Cutter-Mackenzie & Edwards, 2013), *imaginative approach* (Egan, 2005) and the concept of *phenomenon-based learning* from Finnish education.

Purposefully framed play

The importance of play in sustainability education has been increasingly recognized and discussed. There are plenty of studies about the application of playful learning (play-based learning) on sustainability topics in early childhood education (Somerville & Williams, 2015). Among them, *purposefully framed play* was developed by two sustainability

4 main characters
established by Whispter of the Spirit lead the new riddle storyline:



Ukko
Spirit of thunderstorms

Myrrysmies
Magical ancient wizard

Tapio
Spirit of Forest

Vetehinen
Spirit of Water

Figure 12. The selected four characters from Whisper of the Spirit for the extension project (Erfving et al., 2017)

educators Amy Cutter-Mackenzie & Susan Edwards (2013). The authors proposed an integration of three elements as a pedagogical model to support teaching and learning environmental education in early childhood. The model aimed to align the content knowledge with the play-based learning experience. *Figure 13* shows how purposefully framed play refers to the combination of open-ended play, modeled play, and interaction between teachers and children. Whilst, open-ended play implies children's explorative play experience with materials of sustainability concepts with minimal teachers' interaction. And modeled play refers to the teachers' explanation and demonstration of using the materials so to allow children to self-explore. Lastly, interaction between teachers and children refers to the discussion, for instance, with open-ended questions, to connect the play outcome with knowledge and previous experience. The authors claimed that this way of thinking provided multiple opportunities for children to connect content with experience and support their knowledge construction.

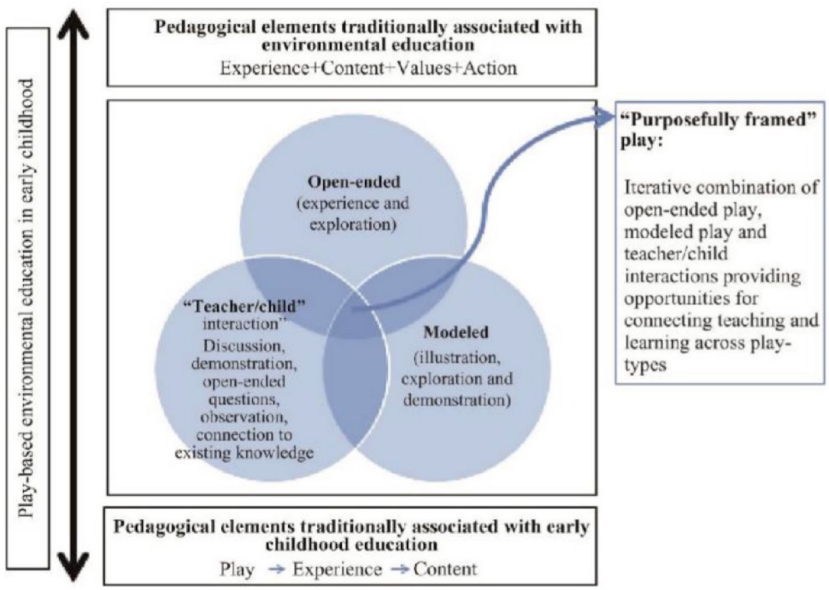


Figure 13. The pedagogical model for early childhood environmental education (Cutter-Mackenzie & Edwards, 2013)

Imaginative approach

The second theory referenced focuses on the use of imagination in teaching and learning. "*Engaging the imagination is not a sugar-coated adjunct to learning; it is the very heart*

of learning" stated by the educational philosopher Kieran Egan (2005, p. 36). In his book an Imaginative Approach to Teaching, Egan (2005) encouraged teachers to engage students through stories in the classroom. The author reminded readers of the important role of stories in the society and the knowledge-making in civilization. He listed a set of cognitive tools, which attempted to support teachers in developing their own approaches to imaginatively engage students. The primary cognitive tools (particularly for young children) include metaphor, binary opposites, rhyme, humour, mental imagery, play, mystery, embryonic tools of literacy and more. To apply these tools, Egan suggested teachers began with a topic that could emotionally engage students. Then teachers may try to identify binary opposites and build up a mysterious setting and lastly resolve the dramatic conflict of the story with students. Through a few examples, Egan demonstrated a story-led framework for teachers to develop their own curriculum units.

Phenomenon-based learning

To ensure this playset applicable to local classrooms, phenomenon-based learning (PhenoBL) emphasized by the Finnish education approach becomes a key reference of this framework. As a multi-disciplinary form of learning, PhenoBL emphasizes holistic learning across subjects' boundaries starting from a real-world phenomenon. This approach is built on the concept of constructivism, which students are considered as active "knowledge builders" and encouraged to explore the phenomenon through observations, questioning and self-directed research (Silander, 2015). In order to achieve the holistic learning, I would like to highlight the importance of multiliteracy competence, which was previously discussed in Chapter 2. As mentioned previously, multiliteracy emphasizes the ability to understand and express diverse mode of communications, such as across media, disciplines, languages and cultural diversity. This competence is seen as vital for students to build an integrated understanding of global issues by acquiring knowledge from different sources across disciplines.

The three theories mentioned above together build the pedagogical approach for developing the playset Riddle of the Spirit. First, the model of purposefully framed

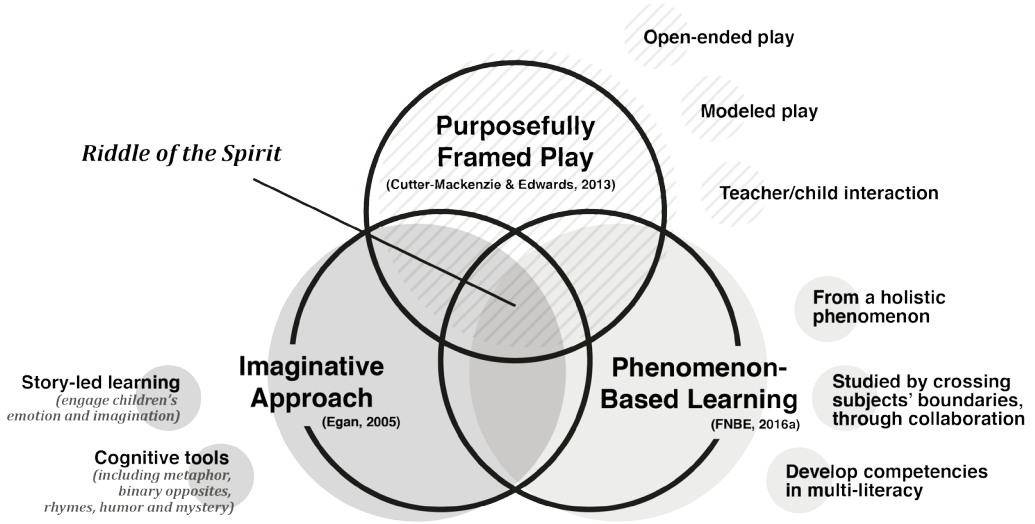


Figure 14. The pedagogical framework of Riddle of the Spirit - integration of purposefully framed play, imaginative approach and phenomenon-based learning (Cutter-Mackenzie & Edwards, 2013; Egan, 2005; FNBE, 2016a)

play provides a guideline in constructing the learning experience structure. The structure is a combination of children's self-exploration with playful materials following teachers' demonstration and a discussion about the play experience and knowledge acquired afterward. The learning experience is a mix of different play types, such as role-play, object play, story-telling, symbolic play, with metaphorical representations. Second, the imaginative approach suggests elements to create a learning setting that can emotionally and imaginatively engage children, thus optimizing the educational values and enjoyment. Third, the approach of phenomenon-based learning shows how children can learn holistically from different perspectives by investigating into a topic across disciplines. In this study, I reference the integration of these three theories as the pedagogical framework for Riddle of the Spirit, referring to *Figure 14* above. This experimental framework acts as a core reference to develop the play structure, in order to optimize educational values and achieve the overall aim stated previously.

5.3 Design criteria

After the data analysis, I summarize the key values and interviewees' expectations as the design criteria for this material development. The criteria establish a prioritization for design and decision-making, attempting to achieve an applicable outcome. There is total of six aspects in the criteria shown as following:

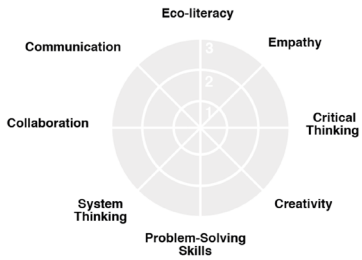


Figure 15. Assessment tool of eight learning values for designed activities evaluation

1. **Knowledge and skills in EarthCore**: besides the knowledge of climate issue as primary learning goals, I identify eight types of skills from the EarthCore principles (Assadourian, 2017) as the secondary learning values of this play experience. The eight values are eco-literacy, empathy, critical thinking, creativity, problem-solving skills, system thinking, collaboration and communication. The radar chart (*Figure 15*) will be used as the assessment tool to evaluate the designed activities.

2. **Pedagogical framework:** as mentioned in the previous sub-chapter, the integration of these three pedagogies are referenced as the playset teaching approach.
   a. **Purposefully framed play:** a combination of teachers' instruction, children's self-explorative play and discussion.
   b. **Imaginative approach:** story-led learning experience by applying cognitive tools, such as metaphor, humor, mystery and binary opposites.
   c. **Phenomenon-based learning:** study phenomenon holistically across disciplines with multiliteracy elements to express creativity in diverse ways.

3. **The playset material design**: the following elements focus on the detail of the physical design.
   a. **Positive and optimistic atmosphere:** allow students to understand climate issues optimistically and encourage them to create positive ideas to address the problems by providing positive feedback.
   b. **Story-based activities:** provide a narrative storyline with descriptive detail to engage children deeply with characters and develop themed-based activities with Finnish-myth-inspired elements. Ensure activities are connected to the storyline and entire play experience.

c. **Open-ended questions:** provide open-ended questions to encourage creative self-exploration and discussion.
d. **Playful illustration style:** inspire and engage children with child-friendly illustrations in a cheerful, playful and carefree style. Engage children to be part of the material creation by providing space on templates for them to create.
e. **Digital play:** embed digital play elements to extend children's creativity and playfulness by utilizing digital devices available.

4. **User-centricity:** the following four elements focus on the practical usability for teachers and students.
   a. **Flexible application:** allow teachers to flexibly apply the activities according to their own planning and schedule.
   b. **Easy-to-make materials:** ensure the learning material is easy to make to minimize teachers' workload. And even engage children in the material preparation process.
   c. **Age appropriateness:** make it suitable for children between the age of four to nine years old, depending on teachers' application and facilitation.
   d. **Child-centricity** – Embed self-directed play and allow children to be active learners in the exploration process.

5. **Learning environment:** these elements refer to the learning environment during the designed play experience.
   a. **A combination of indoor and outdoor activities:** combine classroom activities and outdoor experience to inspire children exploring different learning environment.
   b. **Nature-based activities:** activities may motivate children to go outdoors and encourage them to wonder and observe natural phenomena.

6. **Digital support and distribution:** these two elements relate to the digital system supporting the distribution and information flow of material to users.
   a. **Material distribution:** provide an online channel for teachers to download the materials from the internet. Ensure instruction is easy to understand

and provide flexible download by separating the activities.

b. **Digital support:** the online channel, such as an APP or webpage, might collect feedback from users and allow them to share application outcome and creation online to other users.

This list is basically a summary of key findings concerning the playset outcome from my data analysis. Most of the elements are suggested and discussed with engaged stakeholders during interviews and the prototype evaluation workshop. This list also combines the key values I analysed (in Chapter 2) and my experience in play design. During the design ideation and developing, these criteria are referenced for design decision-making. It will also be used as an evaluation template later in the discussion chapter.

5.4 Playset design and outcome

The next-page *Figure 16* illustrates the playset structure which consists of a riddle storyline, three stations and in a total of seven activities. The riddle acts as the starting point and core discussion throughout the entire learning journey. The main goal for students is to solve the riddle. In brief, the riddle is about the thunderstorm spirit Ukko losing control of the weather, which strongly influenced the crops of villagers (see the entire story in *Figure 17*). Through the play experience, students investigate the question "what is happening to Ukko" and create a solution to make Ukko happy again. After understanding the story, station one "Find" assists students to investigate the riddle and climate issue. In station two "Think", students connect the information acquired to their own daily experience. And station three "Make", students create an ending to complete the story.

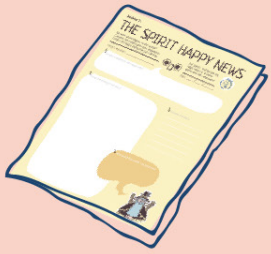
In the trial session, the whole playset was tested with 2 teachers and 32 students of first and second grade (seven to nine years old) in a primary school, Viherkallion koulu, Espoo. The story-telling and seven activities were carried out in two days, in total about 8 hours. 19 out of the 32 students agreed to be photographed and videoed for documentation. The text content of playset was presented in Finnish. The following pages will narrate the interaction between students and activity props with my observation summary.

Figure 16. The playset structure of Riddle of the Spirit

What is happening to Ukko?

Station 3:

Activity 5:
Future-telling cubes



Activity 6:
Spirit Happy News

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4:
t Tower

Activity 7:
Our Shared Future Forest

Riddle of the Spirits

What is happening to Ukko?

The most powerful spirit in Finland is the thunderstorms spirit Ukko. He controls the weather and brings four seasons to all lives on Earth. Ukko is also called the Spirit of Harvest, because he brings sunshine and rain to the people's crops and plants, as well as for their animals and themselves. Ukko is very important to people, because he brings them food.
When the villagers need water, they call Ukko by imitating the sound of thunder and rain. Ukko has three good friends: the magical ancient wizard Myrrysmies, the forest spirit Tapio and the water spirit Vetehinen. Together, they support the people, the nature and all spirits.

One day afternoon, Myrrysmies is taking a nap and two villagers come to him. The villagers look very worried and wake Myrrysmies up. They say, "Myrrysmies! You have to help us! The weather has been strange and unpredictable recently. We have lost a lot of harvest! We don't have enough food for next winter! What should we do?!" Then, one of the villagers start to cry. Myrrysmies shares the feelings of them and replies, "It seems like the weather and climate become strange and irregular. It doesn't sound normal. No worries, I will find out the reason and solve this!"

After the villagers leave, Myrrysmies go to the forest. He asks Tapio and Vetehinen if they know what is happening with the weather. Tapio says, "I also find out the four seasons have changed; it snows in summer time and becomes hot in winter time". Vetehinen replies, " it must be Ukko! He controls the weather and climate. Let's ask him!". So, the three spirits shout loudly, "UKKO----!!" and Ukko appears behind a cloud. He looks sick and depressed.

"Ukko, what is happening?" Myrrysmies asks.
Ukko with tears in his eyes replies, "Myrrysmies, Tapio and Vetehinen! I don't know what is happening to me! I feel so weak and cannot control the weather anymore. You must help me!" The spirits promise, "no worries, Ukko! We will find out what is happening and help you to become strong and happy again!"

My friends, do you want to join this journey and help Ukko to be happy again?

Figure 17. The story of Riddle of the Spirit

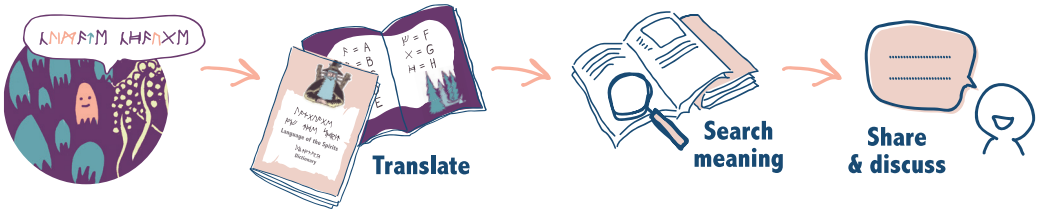
Station 1 - Find

This station assists students to find out information about the riddle through empathy and research. In the first activity *Ask the Spirits*, students acquire keywords, such as "global warming" and "carbon footprint", through translating the designed imaginative "spirit language". The keywords act as the core concepts for discussion throughout the journey. The second activity *Through Spirit's Eyes* helps children to empathize with the story by role-playing spirits and think from their perspectives. This activity encourages students to go outdoors and be inspired through observations.

Station 1 - Key observation

When reading the riddle together, teachers combined playful elements, such as role-play and sound mimicking, to engage students in story-telling. Most students appeared to be enjoying the session. Then, in one classroom, 19 students were split into four groups (four to five students) for the first activity Ask the Spirits. Generally, students were curious about the imaginative "ancient language" and they found it mysterious. After translating, each group acquired a keyword. Keywords were "weather and climate", "global warming", "carbon footprint" and "greenhouse gases". Most of them did not understand these terms before activity. After that, the teacher provided selected reference books for students and guided them to find out keyword meanings. Lastly, each group shared the concept with the others and discussed together. During the discussion, children appeared to be interested in the topic and listened quietly to each other.

In the second activity, starting in the classroom, teacher first introduced the prop and encouraged them to later explore through their senses. Then together we went to the school backyard, which consisted of a playground area and rocks, hill with trees. Students were split into three groups and spent about 5-10 min interacting with each prop. While playing, students role-playing the thunderstorm spirit Ukko tended to go to a higher spot (top of the playground facilities) to act like looking downwards with the binoculars from the sky. And students with the forest spirit Tapio mask stayed and explored in the woods. Students with the water spirit Vetehinen lens explored between the rocks and woods to pretend there was a river between. Afterward, teacher and students together discussed the observation and idea of Ukko's riddle in the classroom. Teachers explained students came up with several ideas to explain Ukko's problem, such as: Ukko might be too lonely in the sky; people have forgotten Ukko; and the cars and its pollution may affect Ukko's health. They also discussed the connection to the concepts acquired from previous activity and started to consider global warming as a reason for Ukko's problem.



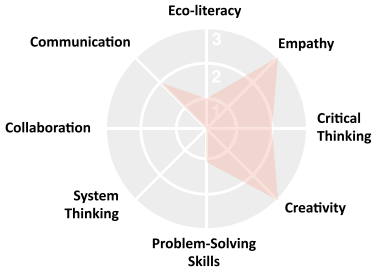
Activity 1 - Ask the Spirits

Instruction

Find out keywords from translating the spirit language. What is happening to Ukko? Spirits may know something. Let's ask them for help. Spirits are everywhere hiding in nature and they speak ancient language. Spot them out and translate what they say! Understand the keywords with dictionary or relevant resources.

Key Learning goals

- Eco-literacy
- Problem-solving skills
- Self-directed research skills
- Collaboration and communication



Play types

- Make-believe
- Mysterious
- Narrative play

Through the Spirits' Eyes

Activity 2 - Through Spirits' eyes

Instruction

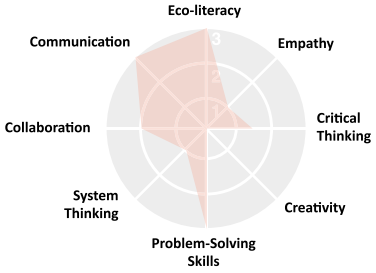
Find out how spirits think by role-playing the spirits! The ancient wizard Myrrysmies has a series of magical tools, which let us to look through the spirits' eyes! The tools help us to find out what the spirits like and dislike. The tools are the Vetehinen magnifying glass, the Tapio mask and the Ukko binoculars. Read the spirits' description on tools to understand more about them. Go outdoor, look through their eyes, think in their perspectives and come up with ideas to solve the riddle! Discuss with the others about your observations.

Key Learning goals

- Empathy
- Role-play, imaginative play
- Communication
- Problem-solving skills

Play types

- Role-play
- Active play
- Make-believe
- Narrative play



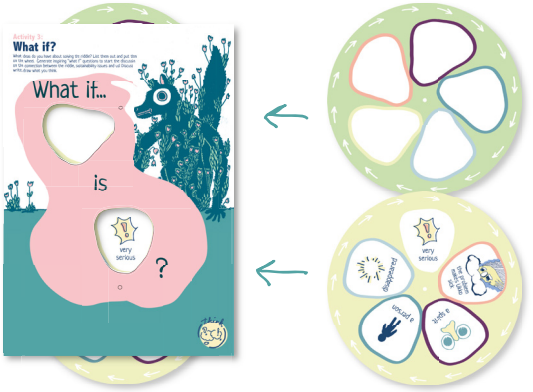
Station 2 - Think

This station focuses on exploring the connection between spirits, climate issues and students' own experience through metaphorical interpretations. Activity *What If?* inspires children to connect their findings to the riddle and climate issues by forming open-ended questions. Activity *Spirit Tower* requires students to build the tower by identifying the linkage of natural resources and consumption for human's activities. It aims to enhance children's critical thinking, system thinking and problem-solving skills. This station attempts to visualize the connection for children to understand human's earth dependence.

Station 2 - Key observation

After three days from the first station, teachers started station 2 by recalling students memory and discussion from the previous experience. Then, four to five students as a group listed out the ideas they had about Ukko's riddle. They shared their findings with the class and teachers summarized and wrote on the wheel of *What if?* template. As a class, they started to discuss their ideas in the relation to Ukko's problem and the concepts learned about climate issues. Because of the material limitation, teachers were holding one *What If?* template to lead the discussion. Teachers commented it would be more playful and engaging if each group has their own prop to interact. This is a valuable comment for material preparation.

In the activity 4, each table has a *Spirit Tower*, some cards with relevant graphics and empty cards. Scissors and pencils were distributed for students to slot cards together and create their own cards. Some groups understood the instruction quickly and managed to build the tower with relevant cards. However, some groups (two out of six groups) didn't manage to build the tower. Some students found it frustrating and difficult to build the tower because the loose joint made the cards easy to fall. Some students seemed to enjoy the process. This experimental activity has the most abstract instruction and the physical props required further development. Some students understood the learning goals but some students did not and they required more help and explanation. However, teachers commented it was a good exercise for children to visualize the connection and it worked in general.



What if... **Global warming** is 

?

What if... **Carbon footprint** is 

?

Activity 3 - What if?

Instruction

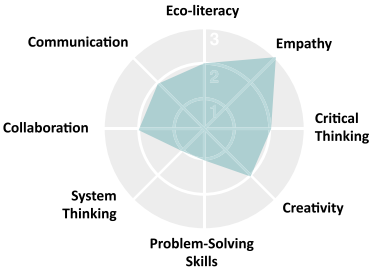
Generate inspiring questions to spark thinking, discussion and creativity. What ideas do you have about Ukko’s problem? List them out and write them on the wheel. Generate inspiring “what if” questions to start discussion on the connection between the riddle, sustainability issues and us! Discuss, write, draw what you think.

Key Learning goals

- Critical thinking
- Communication
- Empathy
- Creativity

Play types

- Narrative play
- Manipulative play



Activity 4 - Spirit Tower

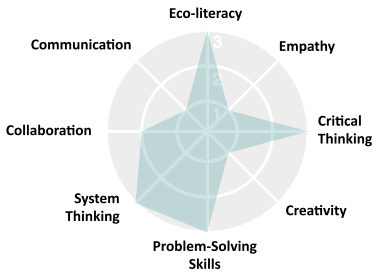
Instruction

How are the spirits supporting us?

How are we connected to the thunderstorms spirit Ukko, the forest spirit Tapio and the water spirit Vetehinen? Explore the connection between the spirits, natural resources and our daily activities! Cut the cards out and slot them together if you think they are related. Make your own cards if needed to extend the connection. Start with the spirits as the base and see how tall the tower you can get!

Key Learning goals

- System-thinking
- Critical thinking
- Eco-literacy
- Problem-solving skills
- Collaboration



Play types

- Manipulative / constructive play
- Social play
- Mapping information
- Art and craft

Station 3 - Make

After exploring the connection of Ukko's problem, climate issues and students themselves, this station focuses on imagining a desirable future and creating ideas to complete the story. It aims to enhance children's creativity, imagination and communication. The activity *Future-telling Cubes* inspires children to create stories with a random combination of elements: humans, spirits, emotion and daily activities. *Spirit Happy News* guides children to create happy endings for Ukko through structural story templates. As the last activity, *Our Shared Future Forest* emphasizes the values of sharing and living together as a closed planetary system. Students create the forest by making wishes for the spirits, nature and themselves as the end of the entire play experience.

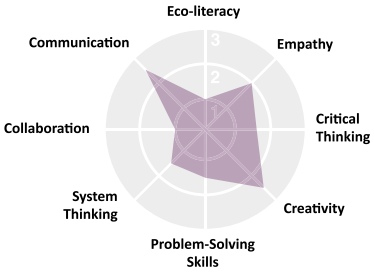
Station 3 Key observation

Due to the time limitation, we combined the activity *Future-telling Cubes* with *Spirits Happy News* and concluded quickly by writing wishes on *Our Shared Future Forest* templates. Teachers firstly demonstrated the cubes by showing all the graphics with a projector in front of the class. Then, each group (four to five students) rolled the cubes several times to obtain a set of randomly-combined elements. Students, as a group, created the story ending on the newspapers template by including the elements. In general, students appeared to enjoy playing with the cubes the most in this station and needed teachers to guide them creating stories. On the other hand, they commented it was difficult to do both activities of story cubes and newspaper at the same time. And some students seemed not to be fully engaged in activities since there were only two sets of story cubes in the room and one newspapers template for each group. Afterward, teachers reflected it would be more engaging if each group had one set of story cubes and every two students created their story. In the last activity, each group was given a big tree template for them to write and draw their wishes for the forest, spirits and themselves. Because of the forest metaphor, their wishes mostly focused on forest and animals, such as translated as "I wish the forest will not be destroyed", "I wish plants grow bigger" and "I wish forest would survive". This observation inspired me to modify the last activity setting as Ukko in the sky to associate their wishes on climate issues.

Activity 5 - Future-telling Cubes

Instruction

Get inspiration from the cubes by throwing them in the air! The ancient wizard Myrrysmies can tell the future from observing the patterns of wood, twigs and stones. He took four future-telling wooden cubes from his magical bag. Can you tell the future of us with the spirits from the cubes? Let's get inspired, create stories and complete the riddle! The story cubes represent different elements, including characters, spirits, emotion and activities. Create your own cubes to be part of the story. Throw them in the air and see what happens!



Key Learning goals

- Communication
- Creativity
- Problem-solving skills

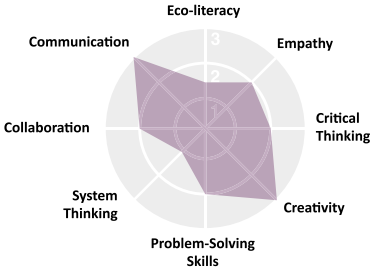
Play types

- Manipulative play
- Narrative play and story-telling
- Creative play
- Make-believe

Activity 6 - Spirit Happy News

Instruction

Spread the happy ending to all spirits. So, what would happen to Ukko in the end? How can we make him happy again? Complete the riddle by creating a happy ending of how you would help him. Spread the happy story to all other spirits with the newspaper!



Key Learning goals

- Creativity
- Communication
- Problem-solving
- Empathy

Play types

- Make-believe
- Narrative – story telling
- Art and craft
- Role-play (if they do drama to complete the story)

Activity 7 - Our Shared Future Forest

Instruction

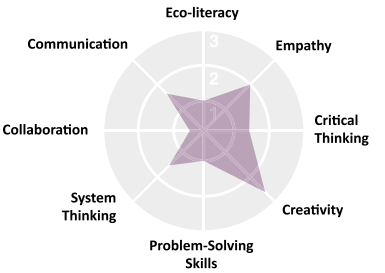
Create a shared forest by making wishes together. What is important to us? What would you wish for yourself, the spirits and everyone as a whole? Write your wish for future on a tree and create our shared future forest together with everybody's wishes!

Key Learning goals

- Empathy
- Creativity
- Communication

Play types

- Make-believe
- Narrative – story telling
- Art and craft



5.5 Trial session feedback

After the two-day session, students, teachers and I discussed together the play experience. Firstly, teachers asked students to raise up their thumbs if they enjoyed the play experience. Out of the 32 students, most students raised one to two hands; about three students replied as "so-so". Reasons include the station "Make" was difficult and the Spirit Tower was difficult to build as it fell easily. Secondly, teachers asked how students think Ukko was related to them. Students shared thoughts, including "*Ukko has a new status nowadays, different from before*", "*climate change is because of us*" and "*we can make Ukko happy again*". Thirdly, teachers asked how students think they could help Ukko to be strong and healthy. Students replied, "*we need to stop pollution*", "*recycle*" and "*shop reasonably*". To sum up, students' answers demonstrated their ability to understand and discuss the climate-issue-relevant keywords, such as "pollution", "climate change" and "carbon footprint" at the age of seven to nine. Students also managed to connect the content knowledge to their observations and daily experience, thus concluding changes in daily practice, such as consumption, recycling, minimizing pollution, as solutions to help Ukko being healthy. They reflected two activities, *Ask the Spirits* and *What If?*, helped to understand their influences to Ukko. Students' learning outcome validated the playset achieving the overall aim of connecting children to climate issues through story and play.

The two teachers generally agreed that the playset trial session was successful. They also found it unexpected how students managed to discuss the newly-acquired abstract concepts of climate issues in the relevant depth. They agreed this age grade of students (7-9 years old) were very suitable for this level of content knowledge and play experience. More, they recognized the flow of activities were important to guide students to explore the topics. And the outdoor experience was important as it inspired students to connect Ukko's story and themselves to the phenomenon of climate issues. On the other hand, teachers also suggested a few improvements for this session. They believed smaller groups, groups of two or three, and more props prepared would optimize the playful learning effect and interaction with the materials. And splitting the activities on different days, for example, two activities per

week would achieve better learning outcome than an intensive two-day session, concerning student's energy level to focus. Lastly, they concluded that this playset could be used as a playful learning material for promoting phenomenon-based learning projects, for example, within the topic of climate change. Their opinion validated the potential values of this project as supporting material in the Finnish new curriculum reform.

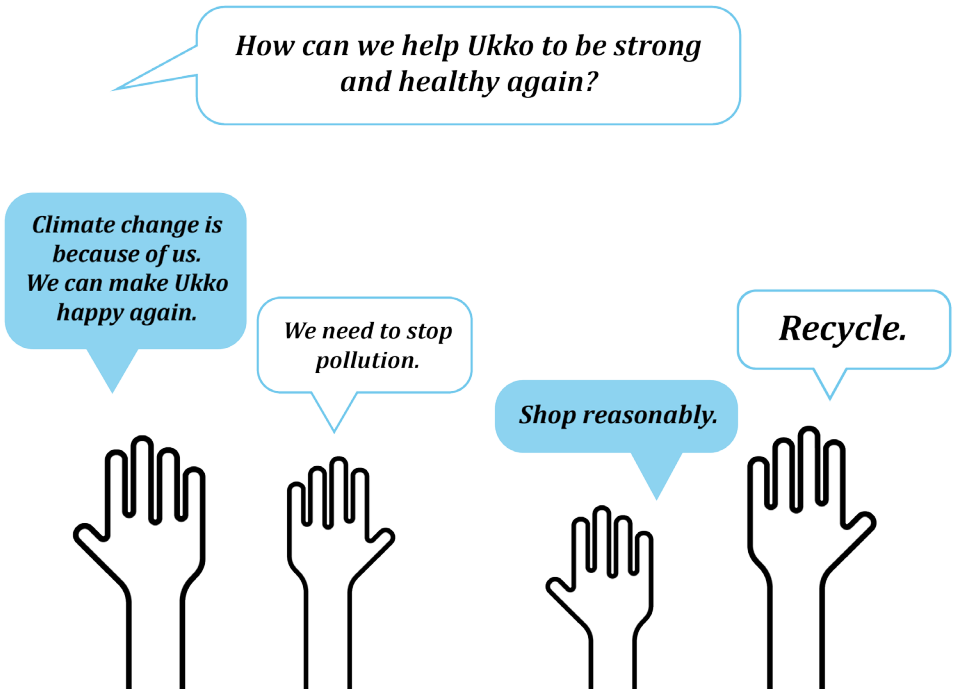


Figure 18. Students'answers in discussion of trial session

6 Discussion

6
Discussion

This last chapter will examine the validity, limitation and further research of this study. I am going to discuss how the findings answer my research question and three sub-questions stated earlier in Chapter 1. Firstly, I will assess this playset design against the design criteria (sub-chapter 5.3) established and highlight the key improvement suggestions. I will also evaluate the potential values of this intervention to various stakeholders, such as students and teachers, and Finnish education system in a broader perspective. Then, I will summarize the limitation of this study. Lastly, I will outline implications for further research, collected throughout the study.

6.1 Validity of research

Referring to my definition of *playful learning design* in Chapter 4, I, created a structure of enjoyable and meaningful play through design, as a process, for children to learn climate issues. I embedded "meaning", which means the learning values, into playful activities. Each activity provides its own "meaning" and constructs the integrated

learning outcome of the whole play experience. With the pre-determined flow of play experience, students acquire the knowledge progressively and build the connection between themselves and climate issues through the story as core discussion setting, the connection shown in *Figure 3*.

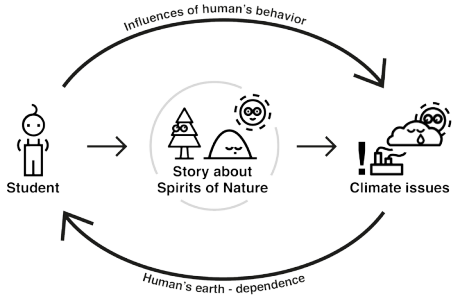


Figure 3. Students connect themselves to climate issues through the story

As previously mentioned, the overall feedback of the trial session suggested that this play design intervention and its experimental pedagogical framework promoted education for sustainability among young children. The students' learning outcome and enjoyment of the play experience were a validation to develop further into publishing for other users. Here, I would like to repeat my research question: *in a Finnish primary school context, how might the design of a playful learning playset promote education for sustainability?* To answer this question, I would like to summarize the key design elements. In my perspective, this play design Riddle of the Spirit has six features:

1. **Explore real-world phenomenon through imaginative stories:** Through the riddle of Ukko as core discussion, students find out information, observe and connect their experience to the real-world topic.
2. **Students act as active learners; teachers act as facilitators:** Students actively construct knowledge and engage in the process of play, observation and discussion. Instead of teachers educating them the information of climate issues, teachers guide students to investigate together. This aims to nurture student's "learn how to learn" skills, referring to the concept of "deep learning" from EarthCore and phenomenon-based learning.
3. **Diverse play types and interaction:** The learning experience is a mix of different play types, including role-play, object play, story-telling, symbolic play with metaphorical representations, including both directed and open-ended questions. And it combines teachers' instructions, children's self-exploration and discussion afterward.
4. **"EarthCore" skills and knowledge:** As part of the learning values, the design aims to enhance students

a set of competences emphasized by EarthCore principles, which was discussed earlier in Chapter 2. Competences include empathy, system thinking, critical thinking, collaboration and problem-solving skills, particularly the concept of deep learning. Each activity was designed to cultivate students' different competences, referring to the assessment tool in sub-chapter 5.4.

5. **Finnish myths about nature as the story setting:** The activities combine several myth-inspired elements, such as the "spirit" characters, the imaginative ancient language of "spirits", *Future-telling Cubes* from the belief that wizards can read the future from stone patterns. As mentioned previously, one of the initial motivation was to leverage the seemed-forgotten Finnish myths.
6. **Easy-to-make paper-based materials:** The materials are designed as easy-to-make and paper-based with a simple mechanism, in order to minimize cost and teachers' preparation effort. The idea was to distribute the playset, as creative commons and non-commercial learning materials, free online through a digital format.

These six features together create the playful learning experience for children to explore climate issues, thus promoting education for sustainability in childhood. These features are developed based on the criteria and pedagogical framework listed in the previous chapter. The criteria act as a summary of key findings to guide the ideation process. However, the list varies constantly throughout the design process due to the new information acquired and the intervention development. The followings are two elements that the playset turned out to be different from the initial criteria:

1. **A pre-determined flow of activities instead of flexible applications:** One of the users' expectation has been repeatedly mentioned during interviews is the flexibility in applying the activities. In Finnish education system, teachers develop their own pedagogical approaches to implement the national core curriculum. For this reason, interviewees highlighted the flexible application since teachers would like to freely choose and adopt the activities according to their own plans, schedules and needs. However, the two teachers participated in the trial session and I realized that the flow of play experience (beginning with a story, an introduction of

key sustainability-related concepts, to observation and discussion) was important for students to understand the concept and relate to their own daily experience to the issue. Therefore, the playset structure consists of an order of activities, to achieve the desired learning goals.

2. **Unachieved digital play elements:** Another initial attempt was to combine digital interaction to extend the playfulness and minimize physical material consumption, by utilizing internet, media and digital devices in classrooms. However, it was difficult to estimate the availability of digital devices in schools. And involving digital infrastructure would demand relevant research effort and stakeholder engagement, such as the field of computer science and digital media, in the design process. Therefore, in this limited study scope, I decided to focus on the role of play design in promoting education for sustainability. The development of digital support will be a further research direction.

In a broader perspective, what values might this playful learning intervention bring to various stakeholders? Responding to the finding of lacking supporting materials for climate education (discussed in sub-chapter 2.3), this project aims to support teachers promoting climate education through playful phenomenon-based learning approaches in schools. In my perspective, I believe this type of playful learning materials provides different values to stakeholders. For example:

Students as players: This material provides them an enjoyable and alternative learning experience with designed props and templates. In the ideal situation, the experience raises students' environmental awareness in climate issues and a sense of responsibility in their daily actions, such as nature conservation and resource consumption.

To teachers, this material can act as a ready-made resource to lower workload, as well as an inspiration for developing other play-based materials. As the two teachers from the trial session pointed out, this material could be used within a phenomenon-based learning module of environmental education. In the ideal situation, this material supports teachers to adapt the education reform of multi-disciplinary modules.

To Playful Learning Centre (PLC), I believe the design criteria and pedagogical framework developed can be utilized for more play-based materials development with sustainability topics or other content knowledge. The design process and user involvement methods can be referenced by educators and teachers for their own pedagogical materials creation.

To my program Creative Sustainability, I believe the study, particularly the analysis of the role of play and sustainability in the Finnish curricula (Chapter 2), is a reference for student teachers interested in studying education for sustainability or the context of Finnish education.

To me as the designer and design researcher, the main value would be the knowledge and experience I gained from the education field by studying and working with relevant stakeholders. The collaboration with PLC provides a valuable network with local teachers and educators, as well as their professional advice on this project. The knowledge I acquired acts as a foundation for me to bridge design and education to promote education for sustainability.

6.2 Limitation of research

During my research, I realize two main limitations of this study. One limitation in the empirical study was the language barrier. As, I do not speak or understand Finnish, my interaction with students, during kindergarten visit and trial session, was limited to body language and visual observation. I could only understand their conversations through teachers' translation and summary. As a result, teachers' translation may slightly change students' actual interpretation and I did not fully capture what students expressed throughout the play process. The other complication due to the language was the time required for translation in user involvements. For instance, in the introductory workshop, an amount of time was spent on the verbal translation during the activities and translating the data collected.

The second limitation would be the evaluation of the playset effect on children. Referring to Kollmuss & Agyeman's model (2002) discussed in sub-chapter 1.2, the

pro-environmental behaviour is difficult to assess or measure. This project attempts to sensitize children about sustainability by leveraging their knowledge and skills, as well as emotional involvements with the characters and story. However, it is challenging to examine the influence of this playset experience on students, in terms of environmental awareness, sense of responsibility and value development. The examination would be limited to observable influences, such as via conversations, obvious habitual change, knowledge acquired in climate topics and actions in nature conservation.

6.3 Further research

To me, this project is a small intervention in the Finnish education system and a beginning for more research and playful learning material creations for sustainable education in early childhood. During the study, a number of future questions raised by engaged stakeholders and myself. I summarized three main further research directions as followings.

The first direction would be to publish this design outcome Riddle of the Spirit and provide it for teachers to use. My interest will be to collect feedback about the feasibility and application of this playful learning material, thus examining values of the design criteria and pedagogical framework established. Based on the feedback, it can be valuable to develop more playful learning projects in this framework to promote other sustainability topics. Apart from this, I am also interested in strengthening children's learning by extending the stories and playfulness into daily school practices. For example, playful interventions with "spirit" characters can be developed for daily use. If possible, I would like to assess the influence of these interventions by observing behavioural changes and collecting feedback.

The second direction is to explore the possibility to embed digital play or interaction elements into the materials, in order to enrich the playfulness and minimize physical materials preparation. As mentioned earlier, this attempt was part of the interviewees' expectation. However, this study did not manage to achieve due to the research scope. This research direction may involve examining the role of

digital learning and digital devices in schools and collecting expectations of teachers and students in this area.

The third direction is to develop a digital sharing platform for exchanging idea in playful learning pedagogies. Currently, PLC and its MOI program provide learning tools support to teachers in Finland mainly through the website, which is a one-way communication channel. In interviews, the PLC educators raised up the possibility to build a two-way communication channel, which could collect teachers' feedbacks as inspirations for further research and development. Moreover, participants of the prototype evaluation workshop also showed interest in a digital sharing platform between local teachers to exchange insights. They pointed out it could be valuable references to find out other teachers' own-developed MLs projects and their new ideas on PLC material application. And this practical exchange of ideas can also enhance the collective learning of teachers to adapt the new curriculum and education for sustainability. Therefore, I identified the potential values in developing a digital channel, such as via website or social media, which could systematically collect feedback from users, as well as a sharing platform of their material creations and application.

Conclusion

Nowadays, the new generation is born into this fragmented world with ecological collapses and new complex challenges. To understand the phenomena and make changes, children will need relatively different competences. For this reason, new movements have been prompted world-wide to stress on alternative educational prioritization and models. At the same time, entering the twenty-first century, a rapid increase in children's mental health problems was observed and found relevant to the widely reported decline of play opportunities in urbanized childhood. Persuasive studies have supported the benefits of play to children's learning, development and wellbeing. Play was also seen as one essential element in promoting sustainable changes to the new generation. Therefore, this thesis began with the motive to promote education for sustainability through leveraging play in early childhood. Through design as a practice and process, I created a structure of an enjoyable and "meaningful" play experience for children to explore the phenomenon of climate change. With the collaboration with Playful Learning Centre (PLC) in University of Helsinki, I had the opportunity to explore this topic from design and education perspectives in the context of Finnish education.

After a five-month design process, I created a playset, Riddle of the Spirit (Riddle), by extending the story of one PLC existing project Whisper of the Spirit, which aimed to promote multiliteracy with elements of Finnish myths about nature. With the goal of solving the riddle, the playset structured a learning journey for students to explore climate issues along with the story of "thunderstorms spirit" Ukko losing his ability to control weather. The set consists of a riddle storyline, a total of seven activities within three stations "Find", "Think" and "Make". It includes instructions, paper toys, props and templates. During the playful learning experience, students were seen as active learners and gathered information about the phenomenon through book research, observation and discussion. Then, they

created an ending to complete the riddle by making Ukko "happy and healthy" again. Referring to the trial session results, students were able to connect themselves to climate issues through the story of Ukko. They concluded changes in their own daily practice, such as changing consumption patterns, recycling and minimizing pollution would be solutions to help Ukko being "healthy". More, teachers participated agreed the playset successfully provided an enjoyable experience to students with inspiring learning outcome. They also believed the age of seven to nine years old was very suitable to use this playset and this material could be utilized as supporting resources for phenomenon-based learning projects in schools.

In general, the playset had a mix of features. The learning experience is a mix of different play types (including make-believe play, object play and symbolic play) with the structure of teacher's instructions, children's self-exploration and discussion afterward. This combination of approaches allowed children to explore actual phenomenon through the imaginative story. And teachers were in the role of facilitators; instead of telling students the content of climate change, they investigated together. To enrich the educational values, the outcome also attempted to develop students' competences of "learn how to learn", which was identified from the core reference EarthCore from Worldwatch Institute. The competences included empathy, system thinking, critical thinking, collaboration, creativity and problem-solving skills. Since Finland was the context, the outcome also referenced phenomenon-based learning approach and used elements of Finnish ancient beliefs about nature as the story setting, such as the "spirit" characters and their backgrounds. Besides, the outcome was designed to be distributed free via the internet, so teachers can download, print and make the props. The materials were mainly paper-based with easy-to-make structure so to minimalize the cost and engage children in the prop-making process. These features were developed based on the data analysis of interviewees' expectations, key values of Finnish education identified and a few selected pedagogical references.

To achieve this outcome, I studied both theoretically and empirically the role of play and sustainability in Finnish education to identify relevant values and factors for design

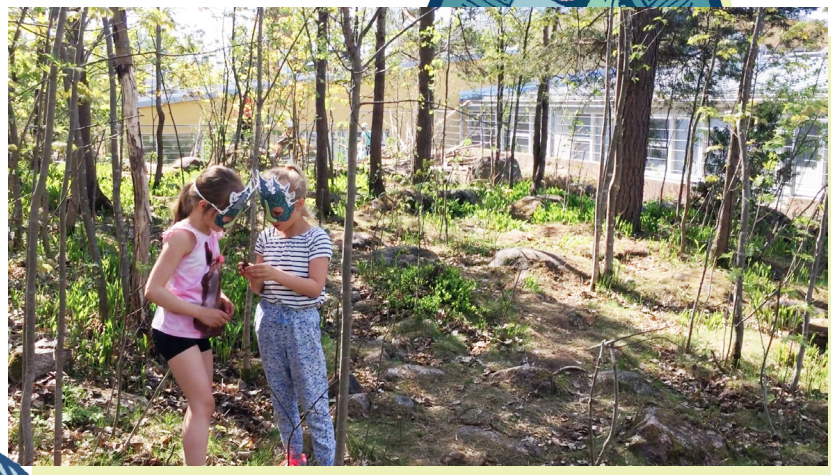
development. By referencing the EarthCore framework, I analysed the Finnish national core curriculum and identified several strengths and opportunities in terms of promoting education for sustainability in the system. Strengths found included: the concept of multi-disciplinary learning modules (MLs); phenomenon-based learning; the emphasis of a "sustainable way of living" in curriculum; play as the main learning method (before children's age of seven), the emphasis of child-centric play and outdoor experience. On the other hands, challenges found included: the vague definition of sustainability-related concepts in curriculum; teachers' concern and struggle in implementing phenomenon-based learning modules, and the lack of guidelines and supporting materials for sustainability-topic education. These challenges are also seen as opportunities for intervention. Therefore, one of the objectives of this playset outcome was to support the education reform as learning materials.

During the design process, I engaged stakeholders in different phases to understand better the context and collect feedback for design development. Engagement methods included an introductory workshop with parents and children, six interviews, a kindergarten observation session, a prototype evaluation workshop and a trial session with children to test the outcome. Among these, the six individual interviews (with educators and teachers) were the most informative and formed my basic understanding of context and criteria foundation. The prototype evaluation workshop was an effective checkpoint as teachers were directly commenting on the design to improve its feasibility and values. Lastly, the trial session in the classroom was a strong validation of the entire design project since the result demonstrated students' positive learning and the design achieved the initial expectations. Each user involvement was an important checkpoint and brought valuable findings to this study.

In my perspective, this thesis brings values to various stakeholders. Sine this playset is a practical outcome; I expect the key contribution would be the application by teachers and students in schools. This ready-made learning materials can support teacher's daily work and implementing the new core curriculum of phenomenon-based learning. To students, it can be an enjoyable learning experience that

motivated them to explore further sustainability knowledge. Moreover, the pedagogical framework is another experimental outcome of this study. I explored a basis for my educational design by integrating three pedagogical approaches of purposefully framed play, imaginative approach and phenomenon-based learning. Along with the design process, research methods and criteria developed, these are useful references for teachers or designers to create more playful learning materials teaching sustainable issues to young students. Besides, I believe this design work will interest readers outside Finland. As the Finnish education has been considered as a successful example by media, people may find this thesis inspiring since it presented some key values of Finnish education, for example, the emphasis of child-centric play in early childhood and the concept of phenomenon-based learning. In fact, the playset design still requires a system to support this intervention, such as the information flow and distribution channels to schools. Therefore, the next phase of this design project would be to build the channel, publish to the public and get feedback to understand the exact application and values to users. Depending on the feedback, it might be valuable to produce more playful learning materials with other sustainability topics or engage teachers in the entire design process to create their own teaching materials. Within the Finnish education system, perhaps this experimental design project is a relatively small intervention. However, I believe it opens up more future research directions in terms of bridging the field of play design and education to promote education for sustainability.

Riddle of the Spirit



References

- Aagaard-Hansen, J. (2007). The Challenges of Cross-Disciplinary Research, *Social Epistemology* 21(4), pp. 425-38.
- Alexander, H. & Orange, R. (2013, December 3) *OECD education report: Finland's no inspections, no league tables and few exams approach*, The Telegraph. Retrieved August 27,2018, from https://www.telegraph.co.uk/news/worldnews/europe/finland/10489070/OECD-education-report-Finlands-no-inspections-no-league-tables-and-few-exams-approach.html
- Archer, B. (1979). The three Rs. *Design Studies*, 1(1), pp. 18-20.
- Assadourian, E. & Mastny L. (Eds.) (2017). *State of the world 2017: EarthEd: Rethinking Education on a Changing Planet*, Washington, DC: Island Press.
- Assadourian, E. (2017). EarthEd: Rethinking Education on a Changing Planet [Introduction]. In Assadourian, E. & Mastny, L. (Eds.), *EarthEd (State of the World): Rethinking Education on a Changing Planet* (pp. 3-20). Washington, DC: Island Press.
- Butler, P. (2016, September 20) *No grammar schools, lots of play: the secrets of Europe's top education system*, The Guardian. Retrieved August 27, 2018 from https://www.theguardian.com/education/2016/sep/20/grammar-schools-play-europe-top-education-system-finland-daycare
- Caillois, R. (1962). *Man, play and games*. Urbana (Ill.): University of Illinois Press.
- Campbell D. & Marsh S. (2016, October 3) *Quarter of a Million Children Receiving Mental Health Care in England*. Retrieved July 31, 2018, from https://www.theguardian.com/society/2016/oct/03/

quarter-of-a-million-children-receiving-mental-health-care-in-england

- Chawla, L. & Derr, V. (2012). The Development of Conservation Behaviours in Childhood and Youth, in Susan Clayton, ed., *Oxford Handbook of Environmental and Conservation Psychology* (pp. 30-31). Oxford, U.K.: Oxford University Press.
- Cross, N. (1982). Designerly ways of knowing. *Design Studies*, 3(4), pp. 221-227.
- Cutter-Mackenzie, A. & Edwards, S. (2013). Toward a model for early childhood environmental education: foregrounding, developing, and connecting knowledge through play-based learning. *The Journal of Environmental Education*, 44(3), pp. 210–211.
- Cutter-Mackenzie, A. & Edwards, S. (2013). Toward a Model for Early Childhood Environmental Education: Foregrounding, Developing, and Connecting Knowledge Through Play-Based Learning. *The Journal of Environmental Education*, 44(3), pp. 195-213.
- Whitebread, D. & Bingham, S. (2012). School Readiness: *A critical review of perspectives and evidence*. United Kingdom :TACTYC.
- Design Council. (2017). *The Design Process: What Is the Double Diamond?* Retrieved January 2, 2017, from https://www.designcouncil.org.uk/news-opinion/design-process-what-double-diamond
- Egan, K. (2005). *An imaginative approach to teaching*. San Francisco: Jossey-Bass.
- Erfving, E., Hintsa, A., Sintonen, S., Sairanen, H. & Kumpulainen, K. (2017) *Whisper of the Spirit*, Retrieved July 31, 2018, from https://helda.helsinki.fi/handle/10138/222483
- Finnish National Board of Education (2016a). *National Core Curriculum for Basic Education 2014*. Helsinki: Next Print Oy.
- Finnish National Board of Education (2016b). *National Core Curriculum for Pre-Primary Education 2014*. Helsinki: Next Print Oy.

- Finnish National Board of Education (2017). *National Core Curriculum for Early Childhood Education and Care 2016*. Helsinki: Next Print Oy.
- Formosa, D. (2012) *'Design Thinking'*, Keynote Address at agIdeas 2013 Advantage, part of the 2013 alIdeas International Design week, Design foundation, Melbourne, Australia, 2 May. Retrieved August 27, 2018, from http://ideasondesign.net/speakers/speakers/dan-formosa-smart-design/
- Frayling, C. (1994). Research in Art and Design. *Royal College of Art Research Papers*, 1(1), 1993/4.
- Golin, J. & Campbell, M. (2017). Reining in the Commercialization of Childhood. In Assadourian, E. & Mastny, L. (Eds.), *EarthEd (State of the World): Rethinking Education on a Changing Planet* (pp. 155-165). Washington, DC: Island Press.
- Hacking, E. B., Barratt, R. & Scott, W. (2007). Engaging children: Research issues around participation and environmental learning. *Environmental Education Research*, 13(4), pp. 529-544.
- Halinen, I., Harmainen, M. & Mattila, P. (2015) Making Sense of the Complexity of the World Today: Why Finland is Introducing Multiliteracy in teaching and learning. *CIDREE Yearbook 2015 - Improving Literacy Skills Across Europe*, pp. 136–153. Retrieved July 31, 2018, from https://www.oph.fi/download/173262_cidree_yb_2015_halinen_harmanen_mattila.pdf
- Hart, J. (2017, August 9) *The big lesion from the world's best school system? Trust your teachers*, The Guardian. Retrieved from https://www.theguardian.com/teacher-network/2017/aug/09/worlds-best-school-system-trust-teachers-education-finland
- Hedefalk, M., Almqvist, J., & Östman, L. (2015). Education for sustainable development in early childhood education: a review of the research literature, *Environmental Education Research*, 21(7), pp. 975-990.
- Huizinga, J. (1938). *Homo Ludens: A Study of the Play-Element in Culture*. Kettering, OH: Angelico Press.
- IDEO (n.d.). *What is Design Thinking?* Retrieved July 31,

2018, from https://www.ideou.com/blogs/inspiration/what-is-design-thinking

- INUSE Research Group (2015). *Human-Centered Design*. Retrieved July 31, 2018, from http://codesign.inuse.fi/human-centred-design
- Jensen, T. S. & et al. (2012). *From consumer kids to sustainable childhood*. Copenhagen: Worldwatch Institute Europe.
- Kollmuss, A. & Agyeman J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behaviour?, *Environmental Education Research*, 8(3), pp. 239-260.
- Krippendorff, K. (1989). On the Essential Contexts of Artifacts or on the Proposition That "Design Is Making Sense (Of Things)". *Design Issues*, 5(2), p. 9-39.
- Kyttä, M., Oliver, M., Ikeda, E., Ahmadi, E., Omiya, I., & Laatikainen, T. (2018). Children as urbanites: mapping the affordances and behaviour settings of urban environments for Finnish and Japanese children. *Children's Geographies*, 1(14).
- Lawrence, R. & Després, C. (2004). Introduction: Futures of Transdisciplinary, *Futures*, 36(4), pp. 397-405.
- Liefländer, A. K., Fröhlich, G., Bogner, F. X. & Schultz, P. W. (2013). Promoting connectedness with nature through environmental education. *Environmental Education Research*, 19(3), pp. 370- 384.
- Lillemyr, O. F. (2009) *Taking Play Seriously*. Charlotte, NC: Information Age Publishing.
- Linn, S. (2010). Commercialism in Children's Lives, *State of the World report 2010*, the Worldwatch Institute, US.
- Lucero A. (2015). Using Affinity Diagrams to Evaluate Interactive Prototypes. In Abascal J., Barbosa S., Fetter M., Gross T., Palanque P. & Winckler M. (Eds) *International Federation for Information Processing 2015,* pp.213-248.
- Lyytimäki, J. & Lähteenoja, S. (2016) *Policy Brief 10/2016: Finland aims to become a sustainable development leader*, retrieved August 24, 2018 from https://www.demoshelsinki.fi/wp-content/uploads/2016/08/

PolicyBrief_en_Finland_aims_to_become_a_sustainable_development_leader.pdf

- McGowan, M. (2018, January 6) *"Too much control": Pasi Sahlberg on what Finland can teach Australian schools*, The Guardian. Retrieved August 27, 2018 from https://www.theguardian.com/australia-news/2018/jan/07/pasi-sahlberg-finland-teach-australian-schools-education
- McGrath, D. & Martinez, M. M. (2017). Deeper Learning and the Future of Education. In Assadourian, E. & Mastny, L. (Eds.), *EarthEd (State of the World): Rethinking Education on a Changing Planet* (pp. 129-139). Washington, DC: Island Press.
- Mehlmann, M., Jorsäter, E., Mehlmann, A. & Pometun, O. (2017). Looking the Monster in the Eye: Drawing Comics for Sustainability. In Assadourian, E. & Mastny, L. (Eds.), *EarthEd (State of the World): Rethinking Education on a Changing Planet* (pp. 117-127). Washington, DC: Island Press.
- Monilukutaito (2017, August 3). *For educators – Whisper of the Spirit*. Retrieved July 31, 2018, from http://www.monilukutaito.com/en/blog/35/haltijan-kuiskaus
- Monilukutaito (2017, July 29). *About Us – The Joy of Learning Multiliteracies (MOI) research and development programme*. Retrieved July 31, 2018, from http://www.monilukutaito.com/en/blog/18/the-joy-of-learning-multiliteracies-moi-research-and-development-programme
- Muratovski, G. (2016). *Research for designers: A guide to methods and practice*. London: SAGE Publications Ltd.
- Niedderer, K., Ludden, G., Clune, S. J., Lockton, D., Mackrill, J., Morris, A., Cain, R., Gardiner, E., Evans, M., Gutteridge, R. & Hekkert, P. (2016) Design for Behaviour Change as a Driver for Sustainable Innovation: Challenges and Opportunities for Implementation in the Private and Public Sectors. *International Journal of Design*, 10(2), p. 67-85.
- Norman, D. A. (1988). *The psychology of everyday things*. New York: Basic Books.

- OECD (2010). Finland: Slow and Steady Reform for Consistently High Results. *Strong Performers and Successful Reformers in Education: Lessions from Pisa for the United States*, pp. 117-135. Retrieved August 24, 2018, from https://www.oecd.org/pisa/pisaproducts/46581035.pdf

- Piaget, J. (1951). *Play, dreams and imitation in childhood*. London: Routledge.

- Piaget, J. (1951). *The Psychology of Intelligence*. London: Routledge and Kegan Paul Ltd.

- Playful Learning Centre (n.d.). *About Us - History*. Retrieved July 31, 2018, from http://plchelsinki.fi/about-us/history/

- Silander, P. (2015) *Phenomenon-based Learning*. Retrieved August 1, 2018, from http://www.phenomenal-education.info/phenomenon-based-learning.html

- Smith P.K. & Pellegrini A. (2013). Learning Through Play. *Encyclopedia on Early Childhood Development*, play, University of London, United Kingdom

- Smith, P.K. & Pellegrini, A. (2013) Learning Through Play. In: Tremblay, R.E., Boivin, M. & Peters, RDeV (Eds). Smith, P.K., (topic Ed). *Encyclopedia on Early Childhood Development*. Retrieved December 14, 2017, from http://www.child-encyclopedia.com/play/according-experts/learning-through-play

- Sobel, D. (2017). Outdoor School for All: Reconnecting Children to Nature. In Assadourian, E. & Mastny, L. (Eds.), *EarthEd (State of the World): Rethinking Education on a Changing Planet* (pp. 23-33). Washington, DC: Island Press.

- Somerville, M. & Williams, C. (2015). Sustainability Education in Early Childhood: An Updated Review of Research in the Field. *Contemporary Issues in Early Childhood*, 16(2), pp. 102-117.

- Stone, M. K. (2017). Ecoliteracy and Schooling for Sustainability. In E. Assadourian & L. Mastny (Eds.), *EarthEd (State of the World): Rethinking Education on a Changing Planet* (pp. 35-47). Washington, DC: Island Press.

- Sutton-Smith, B. (1997). *The Ambiguity of Play.*

Cambridge, MA: Harvard University Press.

- Sweeney, L. B. (2017). All Systems Go! Developing a Generation of "Systems-Smart" Kids. In Assadourian, E. & Mastny, L. (Eds.), *EarthEd (State of the World): Rethinking Education on a Changing Planet* (pp. 141-153). Washington, DC: Island Press.

- Tassi, R. (2009) *Service Design tools – tool role play*. Retrieved August 1, 2018, from http://www.servicedesigntools.org/tools/42

- Taylor, A. (2012, November 27) *Why Finland's unorthodox education system is the best in the world*, Business Insider. Retrieved from http://www.businessinsider.com/finlands-education-system-best-in-world-2012-11?r=US&IR=T

- Tilbury, D. (1994). The critical learning years for environmental education. In Wilson, R.A. (Ed.), *Environmental Education at the Early Childhood Level* (pp. 11-13). Washington, DC: North American Association for Environmental Education.

- Vaajakallio, K. & Mattelmäki, T. (2014). Design games in codesign: as a tool, a mindset and a structure, *CoDesign: International Journal of CoCreation in Design and the Arts*, 10(1), pp.63-77.

- Whitebread, D. (2017). Prioritizing Play. In Assadourian, E. & Mastny, L. (Eds.), *EarthEd (State of the World): Rethinking Education on a Changing Planet* (pp. 107-116). Washington, DC: Island Press.

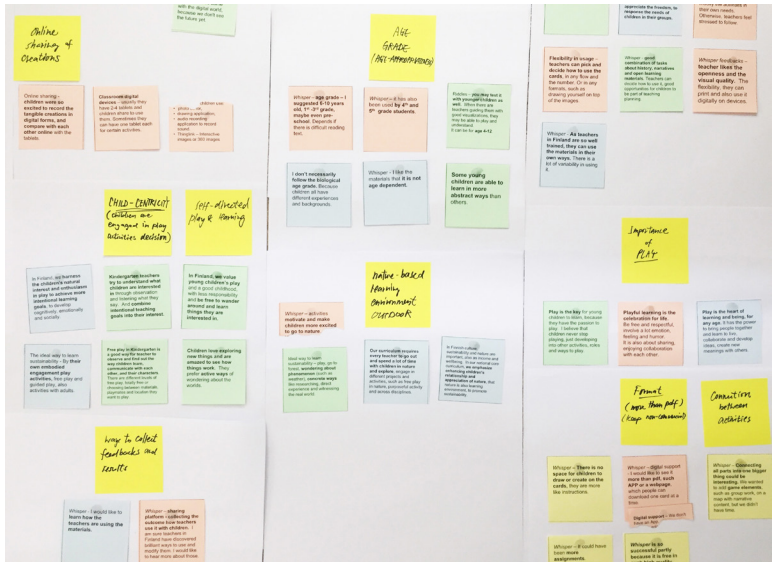
Appendix 1 - Affinity Diagram

The six-interview data is collected mainly through the format of notes and audio. Data is selected and simplified into single data form. In average, around 15-20 insights are selected from each interviewee. Afterwards, data is printed for clustering into groups based on similarities. Each color of papers refers to one interviewee.

Sample of interviewee's insights in single-form data:

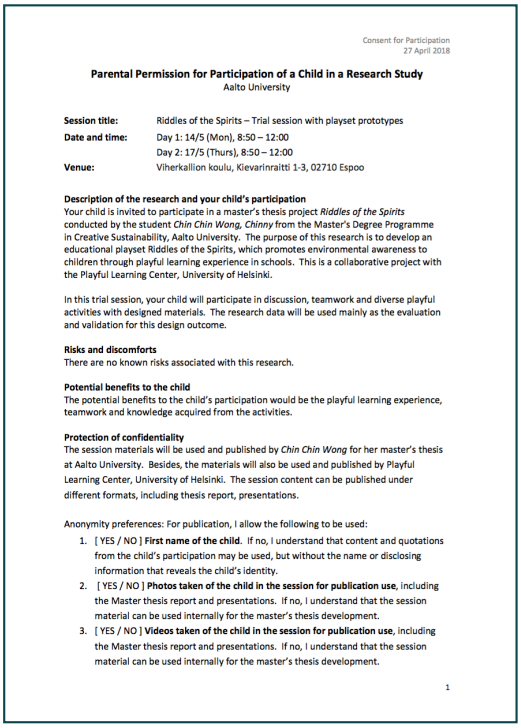
To best demonstrate multi-literacy, is to create open materials, allowing users to decide the ways to use it, develop their own pedagogy and localize the material. It is also open enough to let children to have their own solutions and demonstrate their own thinking.	*Whisper* – **We manage to make the story alive, influence both adults and children.** It also reminds adults these myths. It is will be amazing if it can change adult's thinking and attitude towards things, besides influencing children.	In general, **I don't think all the pictures should be always friendly to children.** So they have the **chance to feel all the feelings,** also the fear and sadness, but in the safe place with adults.	**Illustrations should show the appropriate emotion to children through stories.** Some children understand the story through pictures, as they cannot read the text.	*Whisper* – **There is no space for children to draw or create on the cards,** they are more like instructions.	*Whisper* – **Connecting all parts into one bigger thing could be interesting.** We wanted to add **game elements**, such as group work, on a map with narrative content, but we didn't have time.
Flexibility in usage – **teachers can pick and decide how to use the cards**, in any flow and the number. Or in any formats, such as drawing yourself on top of the images.	**Digital support** – We don't have an App, children use: • photo editor, • drawing application, • audio recording application to record sound. • Thinglink – Interactive images or 360 images	The **role of teachers is extremely important** in this open learning material.	Finnish myths - This is also a point **people can discuss about this with multi-literacy, whether this is real stories or just fictions.**	*Whisper* – It could have been **more assignments**.	*Riddles* – **Try to connect more with the history and the myths.** Perhaps there is ancient language, symbols or characters, we can use in the activities.

An image of clustering printed interview data:



Appendix 2 - Parental Consent Letter

The following is the parental consent letter distributed to students and parents before the trial session in primary school.



Parental Permission for Participation of a Child in a Research Study
Aalto University

Session title: Riddles of the Spirits – Trial session with playset prototypes
Date and time: Day 1: 14/5 (Mon), 8:50 – 12:00
Day 2: 17/5 (Thurs), 8:50 – 12:00
Venue: Viherkallion koulu, Kievarinraitti 1-3, 02710 Espoo

Description of the research and your child's participation
Your child is invited to participate in a master's thesis project *Riddles of the Spirits* conducted by the student *Chin Chin Wong, Chinny* from the Master's Degree Programme in Creative Sustainability, Aalto University. The purpose of this research is to develop an educational playset Riddles of the Spirits, which promotes environmental awareness to children through playful learning experience in schools. This is a collaborative project with the Playful Learning Center, University of Helsinki.

In this trial session, your child will participate in discussion, teamwork and diverse playful activities with designed materials. The research data will be used mainly as the evaluation and validation for this design outcome.

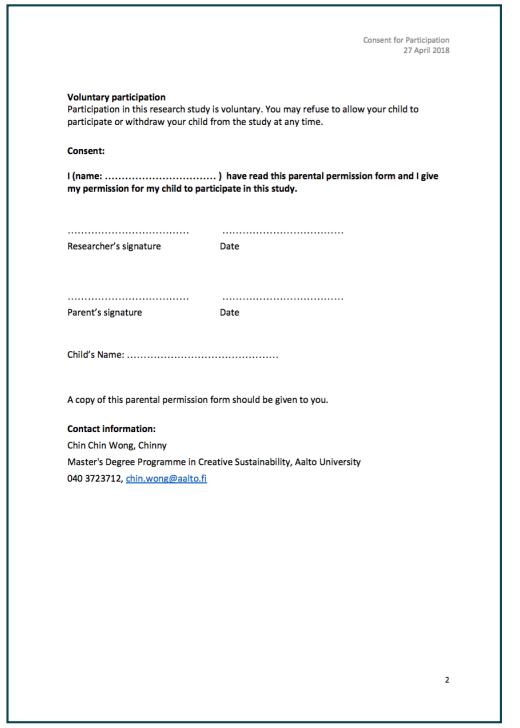
Risks and discomforts
There are no known risks associated with this research.

Potential benefits to the child
The potential benefits to the child's participation would be the playful learning experience, teamwork and knowledge acquired from the activities.

Protection of confidentiality
The session materials will be used and published by *Chin Chin Wong* for her master's thesis at Aalto University. Besides, the materials will also be used and published by Playful Learning Center, University of Helsinki. The session content can be published under different formats, including thesis report, presentations.

Anonymity preferences: For publication, I allow the following to be used:

1. [YES / NO] **First name of the child.** If no, I understand that content and quotations from the child's participation may be used, but without the name or disclosing information that reveals the child's identity.
2. [YES / NO] **Photos taken of the child in the session for publication use**, including the Master thesis report and presentations. If no, I understand that the session material can be used internally for the master's thesis development.
3. [YES / NO] **Videos taken of the child in the session for publication use**, including the Master thesis report and presentations. If no, I understand that the session material can be used internally for the master's thesis development.



Voluntary participation
Participation in this research study is voluntary. You may refuse to allow your child to participate or withdraw your child from the study at any time.

Consent:

I (name: .....) have read this parental permission form and I give my permission for my child to participate in this study.

....
Researcher's signature Date

....
Parent's signature Date

Child's Name: .....

A copy of this parental permission form should be given to you.

Contact information:
Chin Chin Wong, Chinny
Master's Degree Programme in Creative Sustainability, Aalto University
040 3723712, chin.wong@aalto.fi

Aalto University